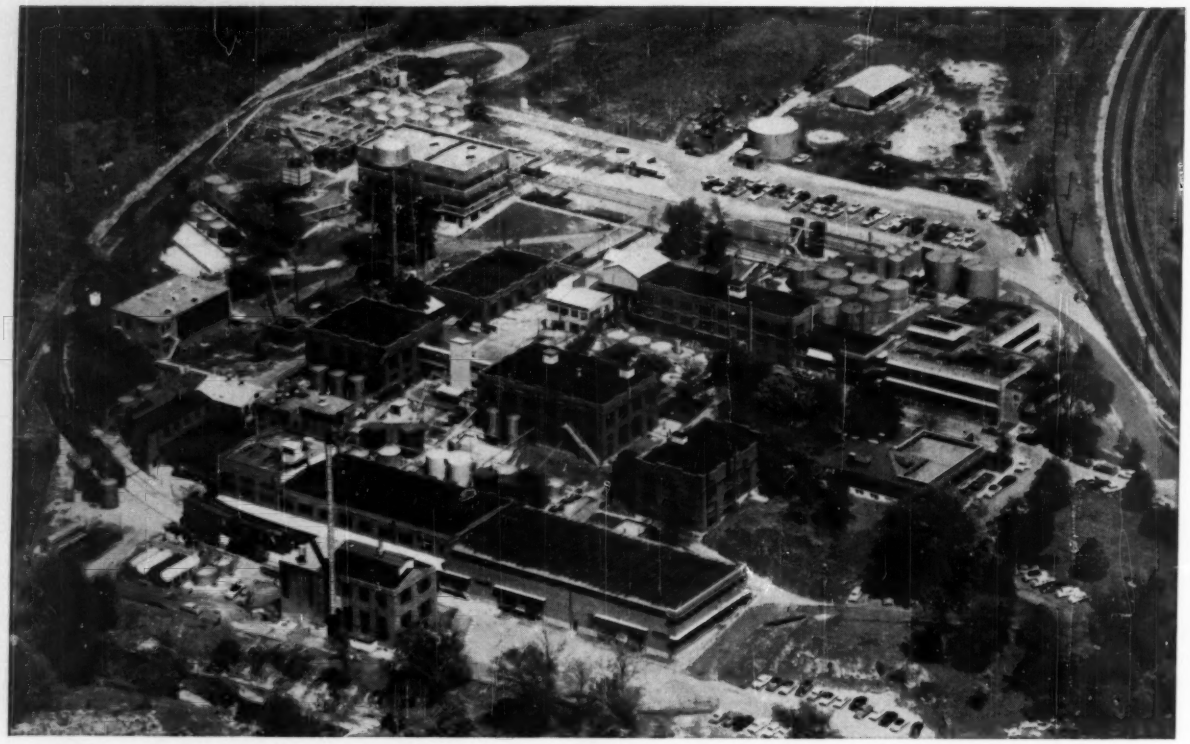
Compressed Air Magazine

NOVEMBER 1960

IN THIS ISSUE:



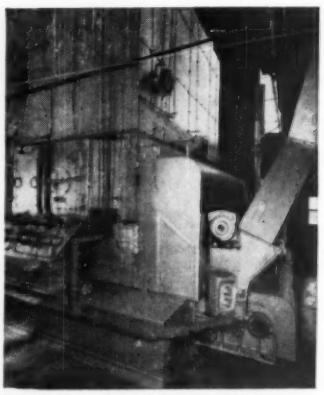
TRETOLITE'S C-E BOILER

carries fluctuating load efficiently burning either coal or gas

A completely dependable source of steam, capable of responding quickly to load fluctuations, is essential for efficient operation in the Tretolite Company's process of manufacturing oilfield chemicals. In 1958, Tretolite, a leading producer of chemicals for industrial use, began operation at its St. Louis plant of a C-E Vertical-Unit Boiler, Type VU-10, fired by a C-E Chain Grate Stoker and equipped to burn gas as an alternate fuel.

The company now reports that this unit has provided thoroughly dependable and efficient steam output firing either coal or gas. Because the Tretolite plant is situated in a residential area, every precaution must be taken to avoid air pollution. Since the C-E Chain Grate Stoker minimizes release of fly ash, Tretolite is able to burn coal without objectionable stack emission.

Combustion's VU-10, designed for use with coal, oil or gas . . . and with capacities ranging from 10,000 to 60,000 pounds of steam per hour . . . is making a consistently good record in hundreds of installations here and abroad. It is just one in C-E's complete line of standardized industrial boilers, built in capacities ranging from 4,000 to 150,000 lb of steam per hour, and designed to provide the best in reliable, low cost steam production. Investigate C-E's advanced designs for your own steam requirements.



Partial view of the C-E Vertical Unit Boiler, Type VU-10, with C-E Chain Grate Stoker installed in the St. Louis Plant of the Tretolite Company. This unit has a continuous capacity of 40,000 lb steam per hr.

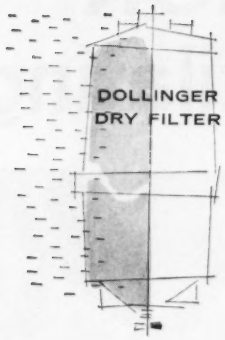
COMBUSTION ENGINEERING

General Offices: Windsor, Conn. New York Offices: 200 Madison Ave., New York 16

***Canada:* Combustion Engineering-Superheater Ltd.**

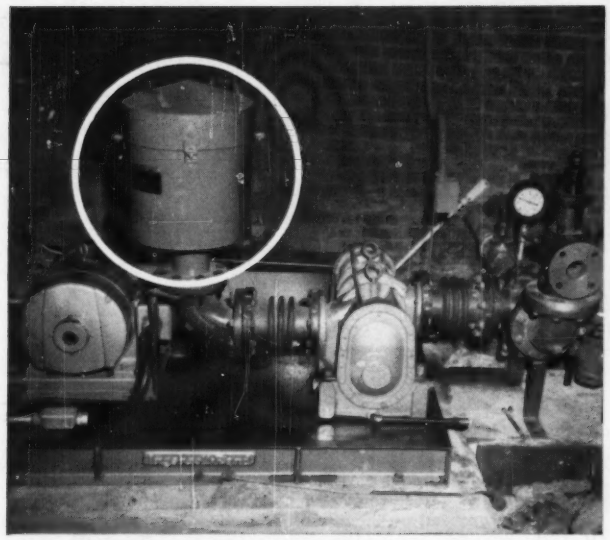
C-2859

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



SPECIALISTS
FOR 39 YEARS

HELP ELIMINATE ICE PROBLEMS AT CENTRAL MAINE POWER



Staynew Intake Filters protect moving parts of compressor that, by producing bubbles in the water, keeps ice from forming around the North Channel dam.

DOLLINGER STAYNEW INTAKE FILTERS prevent dirt and contaminants from damaging a compressor at the Weston Station in Skowhegan —a compressor with the unique function of producing bubbles in the water that keep the North Channel dam ice-free and functioning when temperatures drop as low as −30°F.

Continuous output of hydraulic power from the 12,000 kilo-watt station depends heavily on perpetual trouble-free operation of the compressor. To protect its moving parts, Staynew Intake Filters have been specified. With sixteen square feet of active filtering area, they handle up to 250 cubic feet of air per minute with minimum resistance to flow. This large filtering area also makes possible longer life for the filter medium — in this application at Skowhegan, as long as one year.

Designed for direct application to engines, compressors, and blowers, Staynew Intake Filters are compact, highly efficient, easy to maintain. Available in many models and capacities, they may be the answer to your filtration problems. Find out by contacting your local Dollinger representative, or write for Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, New York.

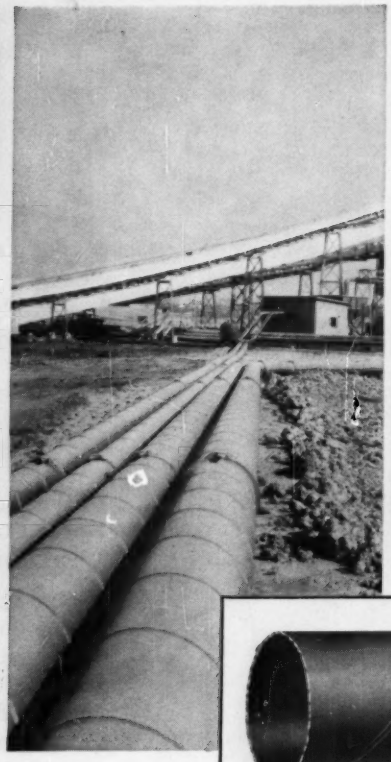
PROTECTOMOTOR

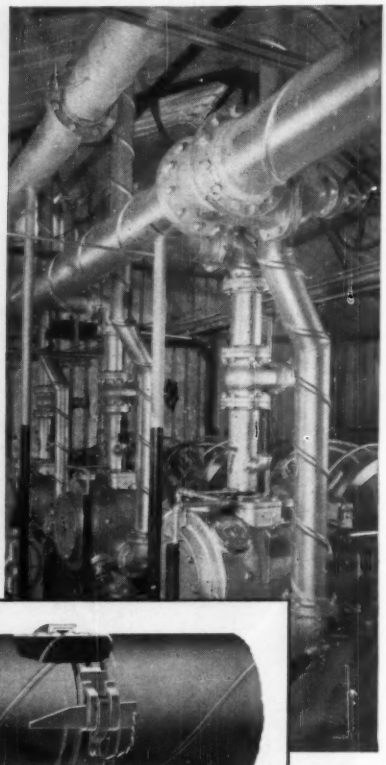
STAYNEW FILTERS

DOLLINGER

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

LINE-UPS by NAYLOR For Air, Water and Ventilating





The NAYLOR Wedgelock coupling is distinguished by its simplicity and effectiveness. It makes a positive connection, securely anchored in grooved or shoulder ends. A hammer is the only tool required to connect or disconnect it.

Here's pipe designed for economical lines in construction service. It gives you light weight without sacrifice of strength. It's easy to handle and install. It's extra strong and safe because the lockseamed-spiralwelded structure absorbs shock loads, stresses and strains.

For air, water or ventilating lines, it will pay you to look to NAYLOR for line pipe and Wedgelock couplings. Ask for Bulletin No. 59 for complete details.

NAYLOR PIPE *Company*

1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

Volume 65 Number 11

November 1960

Compressed Air MAGAZINE

BPA

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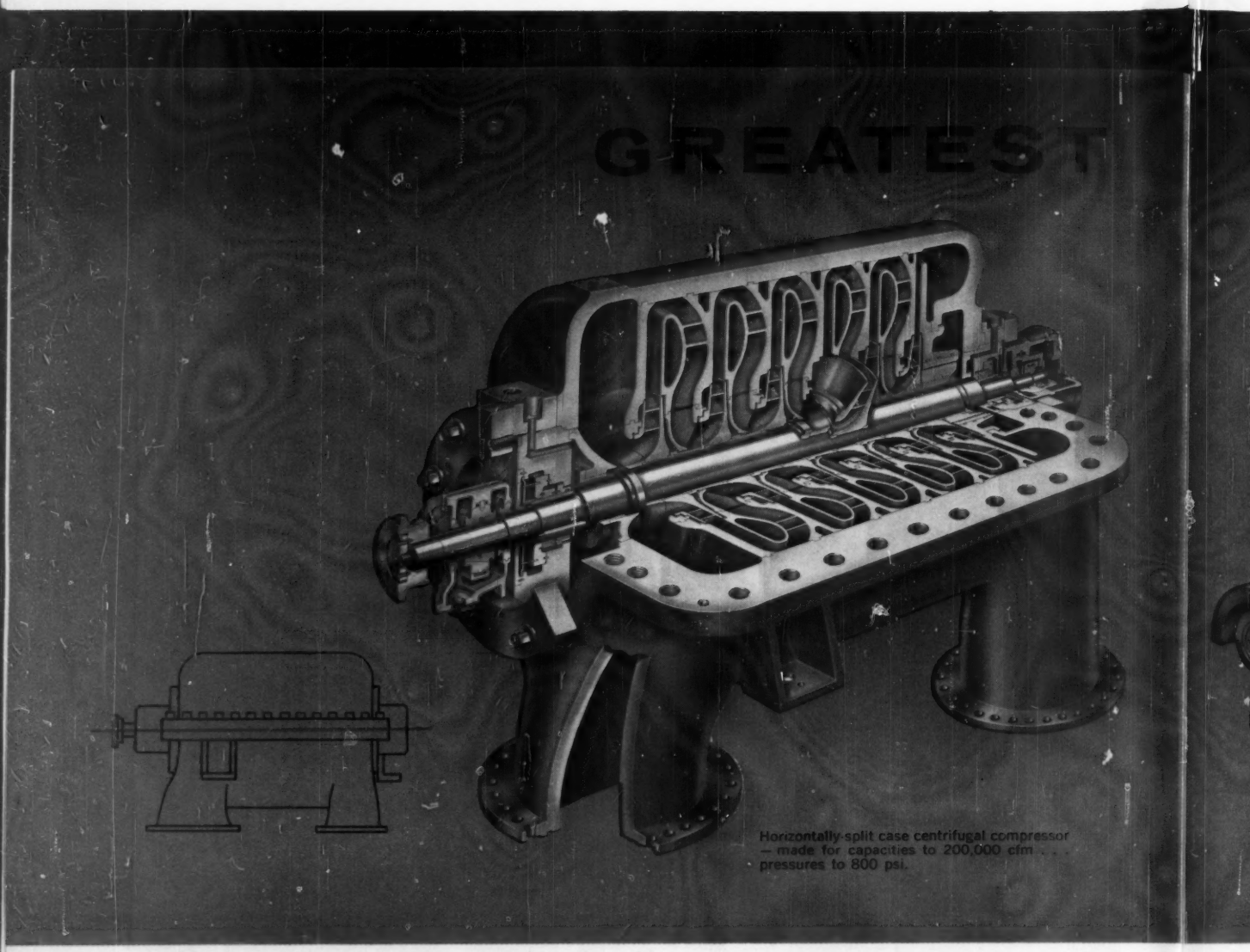
on the cover

Struggle between man and Nature is rarely a peaceful, easy-going relationship. In our 3-part series about Quebec Cartier Mining's venture in the Labrador Trough, we have tried to capture some of the flavor of this conflict. Fierceness of the foray doesn't, however, mean that the outcome one day won't be pleasant to view. As an example, we offer our cover picture. This idyllic scene shows the bridge at Mile 6 on the railroad line described in this month's article, *Building A Railroad North to Nowhere.* The structure's two 270-foot spans were fabricated on shore then floated into place (see page 20) on barges trucked in over the access road. Arbec-Campbell Ltd. built the substructure trucked in over the access road.



Horizontally-split case centrifugal compressor — made for capacities to 200,000 cfm . . . pressures to 800 psi.

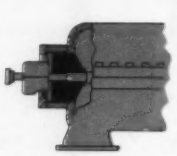
That's why Ingersoll-Rand

EXACTLY WHAT YOU WANT

SELECTING a centrifugal process compressor is often a matter of compromise—arrived at after weighing the economics of standard compressors, optional features and "special" items that might be desirable but not essential.

From a cost standpoint, there's a big difference between optional features and special features. Any competent compressor manufacturer can supply any special features that are needed—at a price. Optional features, on the other hand are ones that have already been designed and can be applied to a standard compressor at minimum extra expense.

The Ingersoll-Rand line of centrifugal compressors is so complete and offers such wide flexibility of design, that the proven optional features available include many items that would be completely special with other makes of compressors. A few of these design modifications are mentioned at the right.

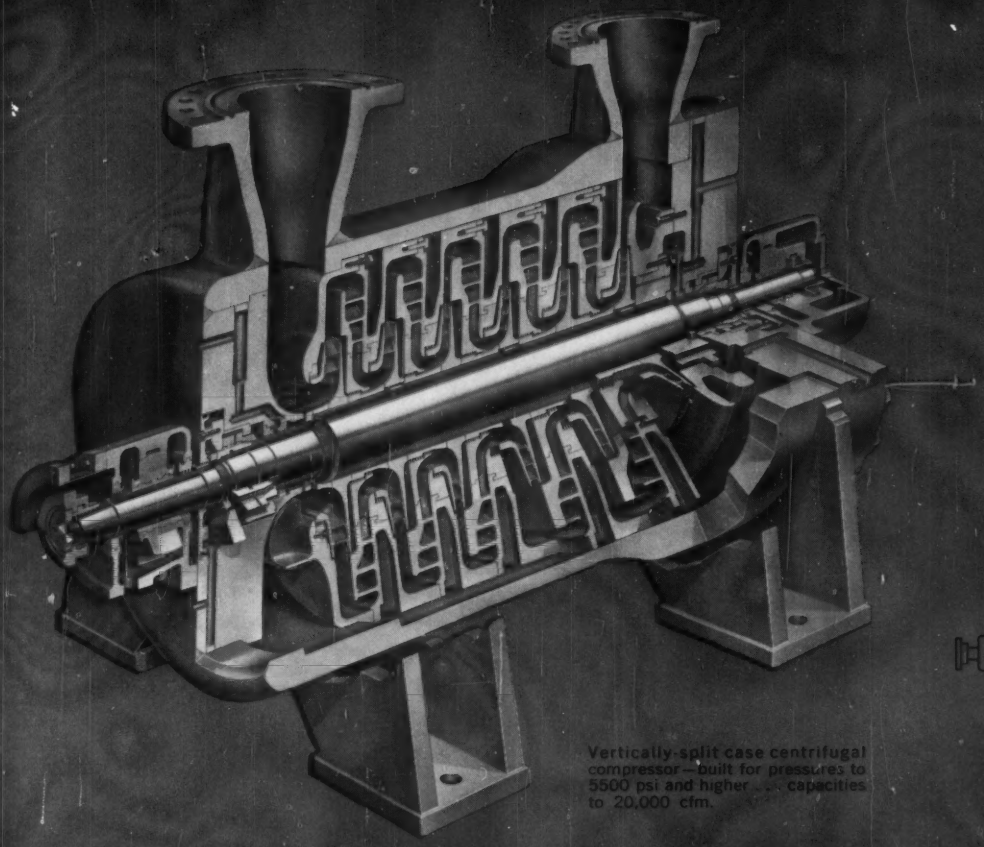


CORRECT SHAFT SEALING. Ingersoll-Rand can provide proven, efficient sealing arrangements for high pressure and vacuum for almost any type of service. The type furnished depends on the gas being handled, the pressure level and the sealing medium.

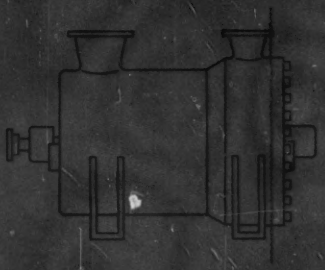
STABILIZED BEARINGS are required for many of the present high speed compressors. Ingersoll-Rand is prepared to offer the correct bearing taking into account bearing loading, lubricant, and journal speed.

Whether your pressure and capacity requirements call for a vertically-split or horizontally-split casing, your exact requirements for any process application can be met to best advantage by Ingersoll-Rand. For further details, contact your experienced I-R engineer.

ADAPTABILITY

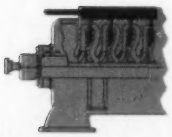


Vertically-split case centrifugal compressor — built for pressures to 5500 psi and higher . . . capacities to 20,000 cfm.

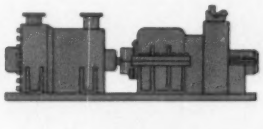


can supply

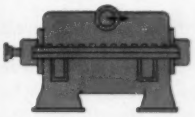
in a centrifugal compressor



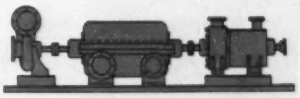
INTERNAL OR EXTERNAL COOLING. On horizontally-split case compressors, water-cooled diaphragms, spray injection or external intercooling can be supplied to prevent exceeding the maximum allowable temperature of the gas, reduce the power requirements, or where a greater pressure rise is required.



MATCHED COMPRESSOR-TURBINE SETS. I-R not only manufactures the world's most complete line of centrifugal compressors but also builds a wide range of driving steam turbines which can be matched to the compressor.



SIDE-LOAD CONNECTIONS. When gas at intermediate pressures is to be introduced or drawn off for other process requirements, side-load connections can be provided.

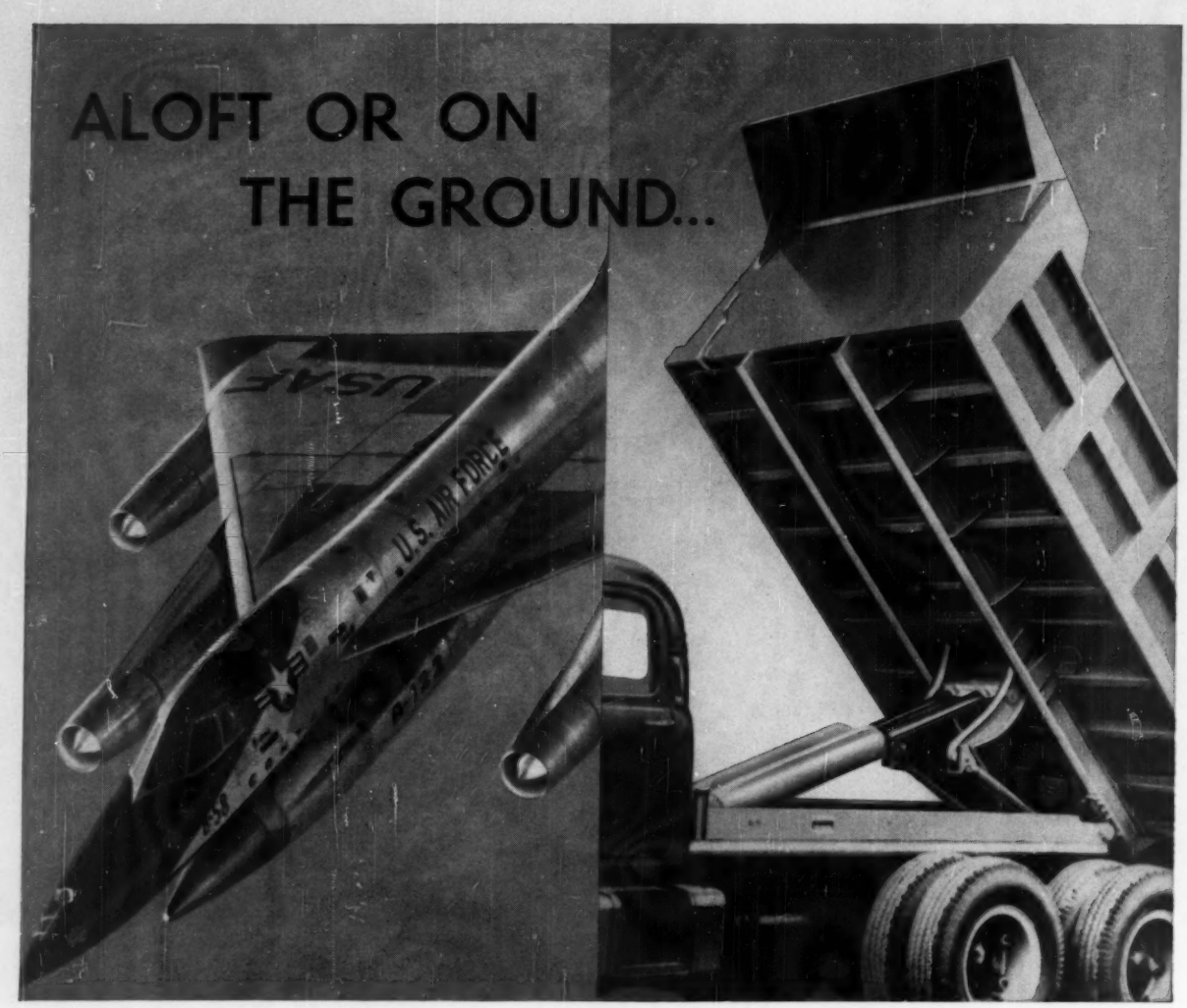


TANDEM COMPRESSOR ARRANGEMENTS. Two or more compressors of any type can be arranged for operation from a common driver, with intake and discharge connections located to meet a wide variety of piping arrangements.

Ingersoll-Rand

127A12 **11 Broadway, New York 4, N. Y.**

PUMPS • CENTRIFUGAL & RECIPROCATING COMPRESSORS • DIESEL ENGINES • AIR & ELECTRIC TOOLS • TURBO BLOWERS • STEAM CONDENSERS



Koppers Sealing Rings give ensured actuation!

Koppers solves diverse and difficult sealing problems.

Modern supersonic jets and dump trucks—as dissimilar as they appear—both depend on Koppers Sealing Rings for efficient hydraulic system operation. Koppers *Predictable Performance* Sealing Rings are used in a wide variety of applications . . . engineered to satisfy each requirement of both hydraulic and pneumatic sealing.

Koppers has the technological skill, gained through 38 years of experience, to meet the most critical performance requirements in any sealing application. Look to Koppers to solve your sealing problems. For an informative booklet on Metallic Sealing Rings write to: KOPPERS COMPANY, INC., 6111 Hamburg Street, Baltimore 3, Maryland.

A Koppers Sealing Ring is applied to a B-58 actuator.

KOPPERS®

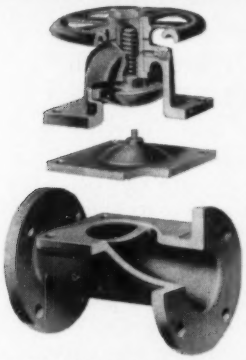
SEALING RINGS

Engineered *Products Sold with* Service

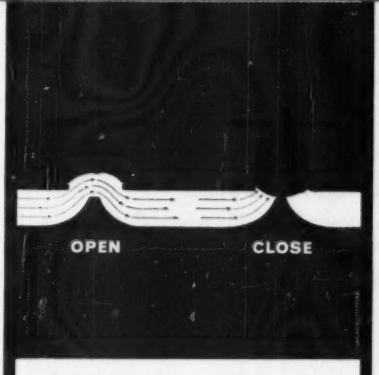
$21,600.00 per year savings in air alone in a large Midwest metal-working plant after replacing all existing air line valves with Hills-McCanna compressed air valves. Year-in and year-out operation with almost no maintenance has provided even greater dollar savings. Of equal importance is ability to maintain required air pressure at point of use, not formerly possible.

Hills-McCanna Compressed Air Valves

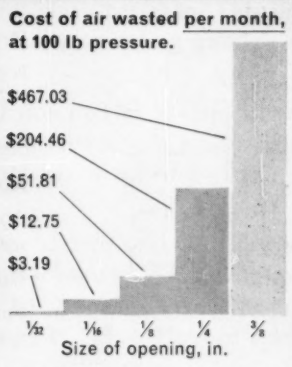
The diaphragm valves that stop air loss, end maintenance problems, and provide positive leaktight shutoff



Simple in-line maintenance. Valve consists of removable bonnet assembly, body, and tough, long-lived diaphragm.



No air leakage. Diaphragm seals bonnet from flow, closes tightly even against solid particles on seat.



The high cost of air leaks is eliminated. Based on air at 7 cents per 1000 cf, chart shows cost of only one small leak.

A complete line of standard and special diaphragm valves for corrosive and noncorrosive air, gas, liquid, sanitary, and vacuum service — ¼" through 16" sizes . . . all end connections . . . manual or motor-operated. Send for literature giving complete data on Hills-McCanna compressed air valves which eliminate air loss, minimize pressure drop, and reduce maintenance to the vanishing point. Write today.

HILLS-McCANNA COMPANY

4600 WEST TOUHY AVENUE, CHICAGO 46, ILLINOIS

Give your toughest jobs to

Purple Plus

Brute Strength

For any job requiring brute strength, Bethlehem Purple Plus, with IWRC, is the rope to use. This fine rope is specially engineered, and is rated 15 pct above the catalog strength of Bethlehem Purple Strand, a fine rope in its own right.

Abrasion-Resistance

Abrasion-resistance is where Purple Plus shines, thanks to its tough wires, and the extreme care with which the rope is made.

Durability

Purple Plus is designed for rugged service, thus promoting lower wire rope costs.

Purple Plus, with IWRC, is your best buy for the toughest jobs. It is Preformed for easy handling. Full details from the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Wire rope mill depots and distributors from coast to coast stock Bethlehem Rope

BETHLEHEM STEEL

GENERAL ELECTRIC

now!

Tri-Clad '55' motors with THERMO-TECTOR* system

WARRANTED

against burnout from overheating

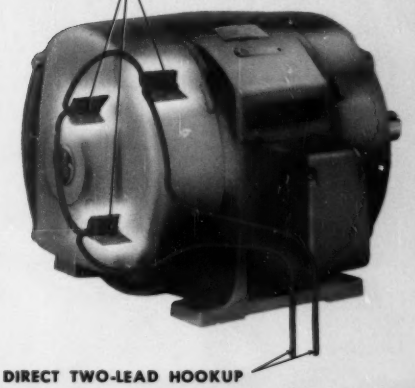
For the *first time* General Electric offers you a motor with such *positive* protection it is WARRANTED in writing against overheating burnout!

G.E.'s exclusive new THERMO-TECTOR system gives Tri-Clad '55' motors truly *inherent* over-temperature protection. Unique variable shut-off feature allows motor to deliver *full power potential* under all operating conditions. Fail-safe THERMO-TECTOR system has simple, two-lead hookup.

*Trade-mark of General Electric Co.

For the first time General Electric offers you a motor with such *positive protection* it is WARRANTED against *overheating burnout*

HEAT-SENSING SWITCHES



DIRECT TWO-LEAD HOOKUP

TURN PAGE FOR FURTHER INFORMATION

NOW - A Motor *Warranted in Writing* Against Overload Burnout!

General Electric Company warrants to the Purchaser that the Tri-Clad '55' motor with Thermo-Tector system delivered hereunder will:

(a) Not burn out because of overheating resulting from overload, lack of ventilation, single-phasing, stall, high ambient, or voltage unbalance, as long as the Thermo-Tector switches are connected into the control circuit so that power to the motor is removed when an over-temperature condition occurs;

(b) Be free from defects in material, workmanship and title; and

(c) Be of the kind and quality designated or described in the contract.

The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral, or implied (including any warranty of merchantability or fitness for purpose). If it appears within one year from the date of shipment by General Electric Company that the equipment delivered hereunder does not meet the warranties specified above and the Purchaser notifies the General Electric Company promptly, the General Electric Company shall thereupon correct any defect, including non-conformance with the specifications, at its option, either by repairing any defective part or parts or by making available at the General Electric Company's plant, a repaired or replacement part.

The liability of the General Electric Company to the Purchaser (except as to title) arising out of the supplying of the said equipment, or its use, whether on warranty, contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of said one year, all such liability shall terminate. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the General Electric Company.

General Electric's *exclusive* THERMO-TECTOR system is available now on *all* Tri-Clad® '55' motors in frames 254U-445U. Contact your General Electric Apparatus Sales Office or Authorized Distributor *today* for details on this NEW FULLY WARRANTED MOTOR PROTECTION SYSTEM. Or, write for Bulletin GEA-7092, Section 866-04, Schenectady 5, N. Y.

SMALL AC MOTOR & GENERATOR DEPARTMENT

GENERAL ELECTRIC

An 8 per cent increase in production with new grinder produced 600 per cent return in investment

P lanned

A nnual

R etooling

pays 20% dividend on grinding payroll

This foundry found that their grinding operations were proving a "bottleneck"—unseen payroll dollars were being lost because their grinders were not as efficient as they could be. A study was made and it was found that by adopting a Planned Annual Retooling program and replacing 25% of their grinders each year, production efficiency could be increased by 20%. Here is just what that 20% meant as a dividend in dollars and cents.

They employed 15 grinder operators at an annual wage of $4580 per man. This meant a grinder payroll of $68,700. These men spent half of their time actually operating grinders so their actual grinding time payroll was $34,350.

Since they would realize a 20% increase in grinding production on this $34,350, they would realize a gross dividend of $6870 per year on grinding alone. The investment in new grinders to produce this dividend was only $937.50, giving them a potential *net dividend on their grinding time payroll of $5932.50.*

If you use any type of portable power tools in your production, remember—it's the man behind the tool that counts! The part of his wages that is lost because of lowered production through inefficient tooling, can very soon far exceed the cost of a new tool. Get the complete facts on the profit producing potential of portable power tool analysis. Write for your copy of "How Planned Annual Retooling earns you a dividend on payroll dollars" and handy slide rule computer.

Ingersoll-Rand 11 Broadway, New York 4, N.Y.

Planned Annual Retooling increases output per man

41A-8

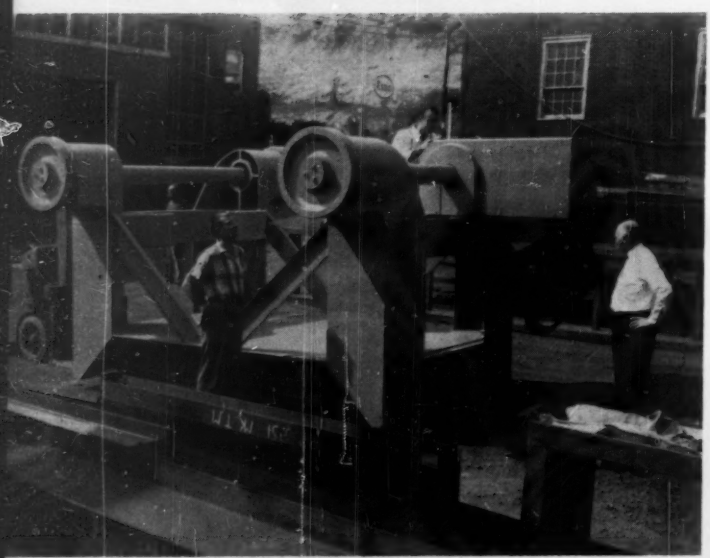
Special Vehicles

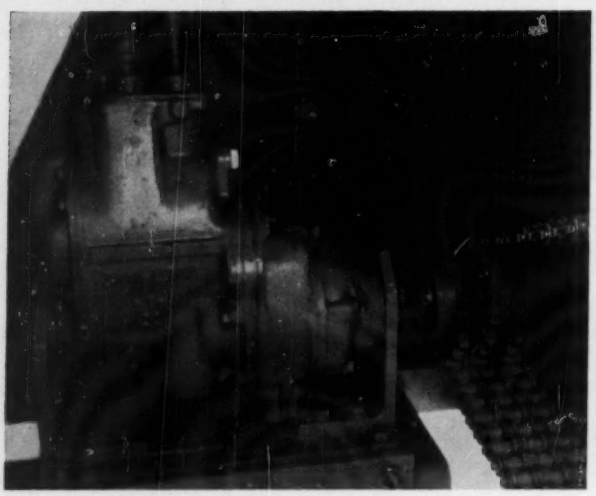
Built-to-Order

Be the Cargo Hot Steel or Hot Atoms, Air Drives Cars Safely with Full Control

G. R. Smith

FOR a small company, the law of survival in today's industrial jungle reads: specialize to the teeth. This is the axiom that Ben Johnson Associates, Inc., Bangor, Pa., has followed successfully during its short lifetime. Founded in 1956 by its president Ben Johnson (who had just resigned as vice president of a large construction and industrial vehicle maker), the company is building a business of designing and fabricating heavy industrial trailers and transfer cars. Two examples of the concern's work are shown on these pages: a ladle-transfer car for Midvale-Heppenstall Company, a Philadelphia steelmaker, and a weigh-scale transfer car for the





LADLE-TRANSFER CAR At left, a final inspection is given the car at the fabricators. The air motor is housed in the enclosure in front of the white-shirted man. The picture at below left shows the motor and the triple-pitch drive chain.

CAR AND LADLE ARE MOVED TO FURNACE, THEN

Atomic Energy Commission at an AEC facility. Compressed air motors drive both cars.

Swindell-Dressler Corporation, Pittsburgh steel mill designers and producers of electric furnaces for steel production, installed the ladle-transfer unit at Midvale-Heppenstall's plant. The steelmaker recently completed the conversion of its open-hearth shop to an all-electric arc-furnace department. Three Swindell furnaces were put in: one 20-foot-diameter shell of 120-ton capacity, one 17-foot-diameter shell of 60-ton capacity, and a 13½-foot-diameter shell of 30-ton capacity. The three furnaces and their respective transformer vaults were installed in the charging bay of the shop and tap into the casting bay. During the conversion it was found that the existing crane approach for charging and electrode installation worked well for the two larger furnaces, but an extraordinarily long spout would be needed during tapping of the 13½-foot furnace. This was why the ladle-transfer car was built. It operates in the tapping pit by cradling a ladle that receives the newly made steel. Instead of requiring pouring over a long distance with a spout, the air-powered car moves the ladle right up to the shell for direct pouring. After the ladle is filled, the air motor is actuated and the car and ladle move to the far end of the pit where the crane can reach the ladle.

The car is supported by four overhung wheels, each pair having a 7-inch forged-steel axle. The cast steel wheels run on roller bearings. One of the axles is driven by the air motor working through a triple-pitch chain. Constructed of 1- and ½-inch steel plate, the unit houses its 5-hp, 90-psig Ingersoll-Rand air motor in an enclosure at the end opposite the pouring end. Two pairs of Appleton air-hose reels—one for forward and one for reverse movement—keep lines under control. One is installed below the air-motor enclosure and the other in a fixed location at the far end of the pit. The car will carry 100,000 pounds.

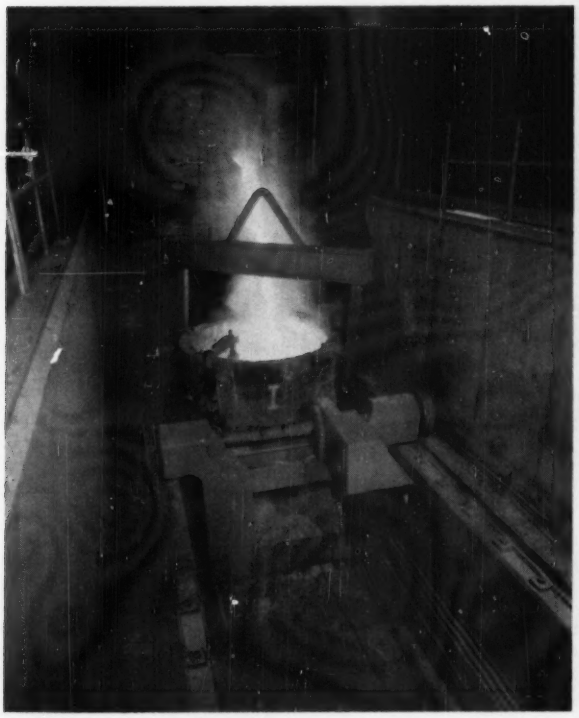
Air for Safety

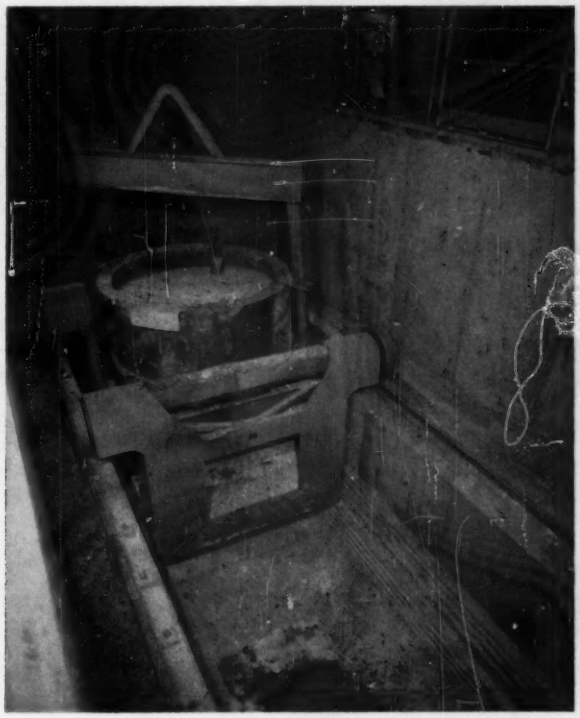
Air drive was installed chiefly for safety reasons: if electricity were used, there would be danger of liquid metal burning away insulation and exposing electric lines. Besides being safe, the air motor is desirable because it allows continuously variable speeds up to its maximum of about 30 feet per minute. This smooth operation permits easy, nonspill starting and stopping of the car as its big pot of liquid steel moves along the pit. Limit switches control the total length of movement. Another advantage of using air is that the car's drive mechanism costs only about 50 percent of an equivalent electric power unit.

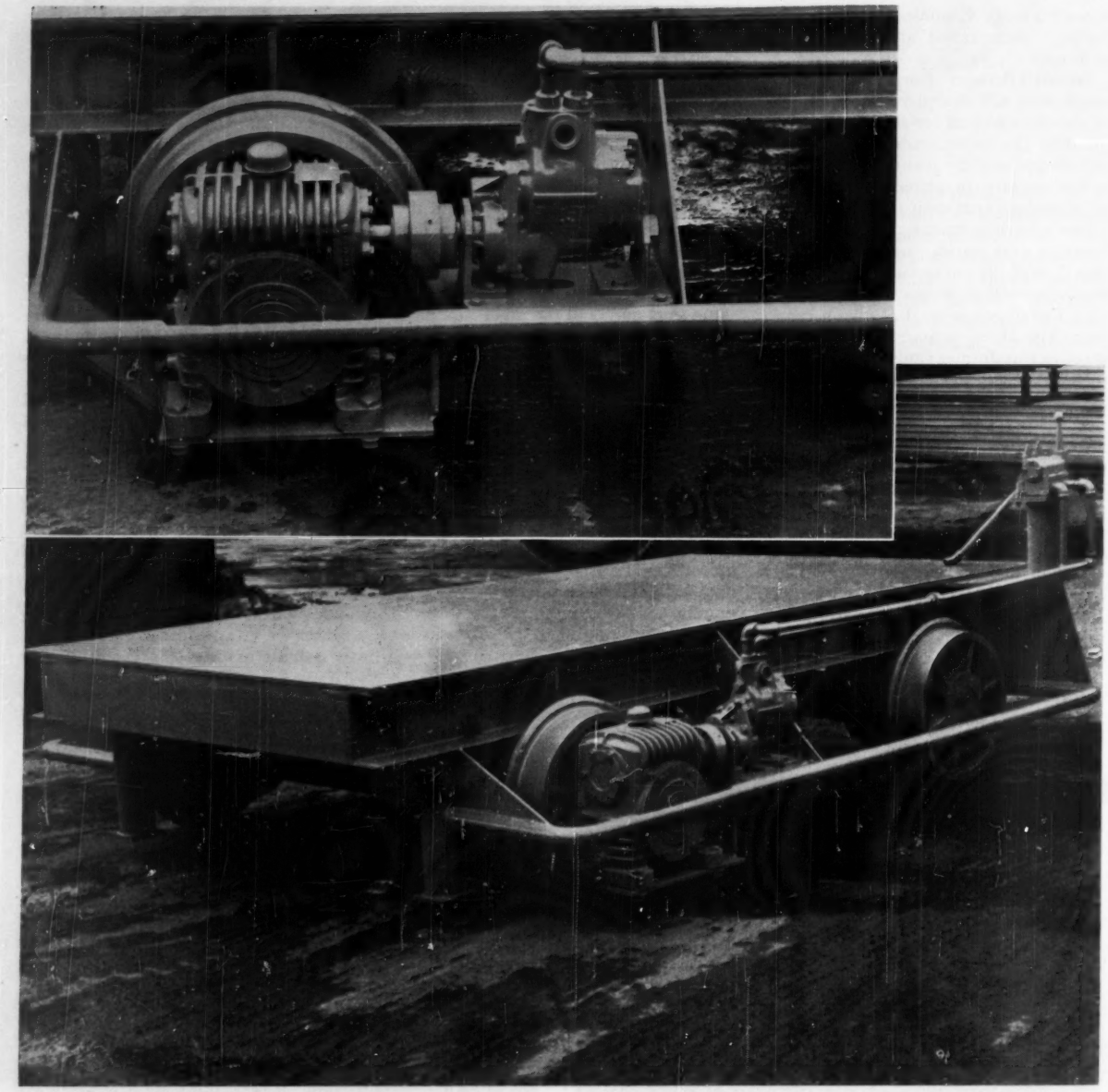
Safety was the primary reason also for installing a compressed air motor drive on the Ben Johnson-built weigh-scale car shipped to the Atomic Energy Commission installation. Used for scale calibration, the vehicle is occasionally loaded with 36 test-weight billets weighing 1000 pounds each, then moved onto a scale to check accuracy. The complete car, according to customer specifications, couldn't weigh more than 4500 pounds though it had to carry 36,000. The use of the air motor produced a secondary advantage by saving 150 pounds of weight over that of a comparable electrical drive.

The car is built of structural steel shapes and has a deck of smooth steel plate. Wheels are flanged cast steel with a standard gauge—4 feet 8½ inches. Powered by an Ingersoll-Rand 2½-hp air motor working with 90-psig air, the driver output goes through a Cone-Drive Gears unit to a single axle. The input turns at 580 rpm; the unit has a 50:1 ratio and produces 1½ hp. The air motor and gear are held by a projecting shelf on the side of the car where a safety rail is built to protect persons working near the machine. Controls for the air motor are on a small post at one corner of the upper flat surface. An Olean reel,

. . . FURNACE TILTS TO FILL LADLE WITH MOLTEN STEEL. LADLE NEXT IS MOVED TO FAR END OF PIT.







WEIGH-SCALE CAR **Before shipment to the Atomic Energy Commission. The picture immediately above shows the unit's flat load-bearing surface, its air motor driver and reduction gear assembly, flanged wheels, and pedestals that would catch the load if an axle failed. At far right is the post for control of the air motor. The inset shows motor and gears.**

affixed near the scales, takes care of hose; Hansen couplings make quick work of connecting and disconnecting the hose system.

Cylindrical pedestals project down from each of the car's four corners as a safety feature. They have metal plate bottoms and 1-inch clearance above the surface on which the car's wheels rest. These pedestals would catch the extremely heavy falling load if an axle should fail. The car has a finish of gray Amercoat paint.

Not all of Ben Johnson Associates' cars are air powered of course. The company's bulletins list some 20 transfer cars and 25 trailers. Some have air drives and others, electro-hydraulic propulsion. Several have no driver, and appear as extremely rugged, low platforms of structural shapes with small chilled-iron wheels on stubby axles. The greatest-capacity model of the line is a gasoline engine powered car that will tote 125 tons.

In general, the transfer cars and trailers are produced to specifications of customers in the metal-making, metalworking, construction, chemical, electrical and instrument industries. One boon to the young concern was its winning a healthy chunk of the business of building liquid oxygen generating trailers. Ben Johnson Associates builds the highly compact sheet-metal enclosure and sturdy running gear, then sells the unit to chemical engineering concerns. There, the enclosure interior is literally stuffed to the walls with the oxygen generating equipment and instruments. Such trailers are towed up to missile launching pads where they produce the lox that is pumped into various missiles for use as fuel. With a good percentage of U. S. missile shots, Ben Johnson Associates can say the company helped the big birds on their way either to a target or on into orbit.

Mike Smith

Compressed Air Helps To Make A Chair

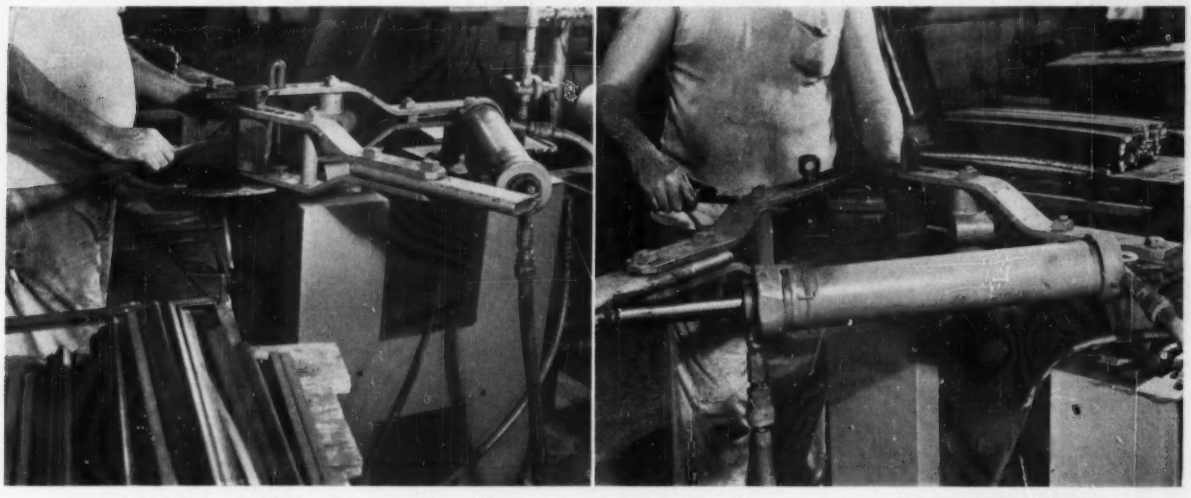
BENDING, shaping, cleaning, rust-proofing and painting solid steel into machine-wrought furniture is the multiple task for air power in a Hialeah, Fla., factory. The company's name, da Vinci, Inc.; its product, so graceful it appears to be handcrafted, so elegant it would become a formal living room, and yet so durable it will stand up in any weather.

The da Vinci factory began in a small garage in downtown Miami a decade ago. The present facilities include not only roomy factory areas and special booths for cleaning processes and spraying of aluminum, but spacious air-conditioned showrooms. The plant is served by three air compressors—rated at 50, 20 and 15 hp—connected by air lines to machines and air cylinders throughout the plant.

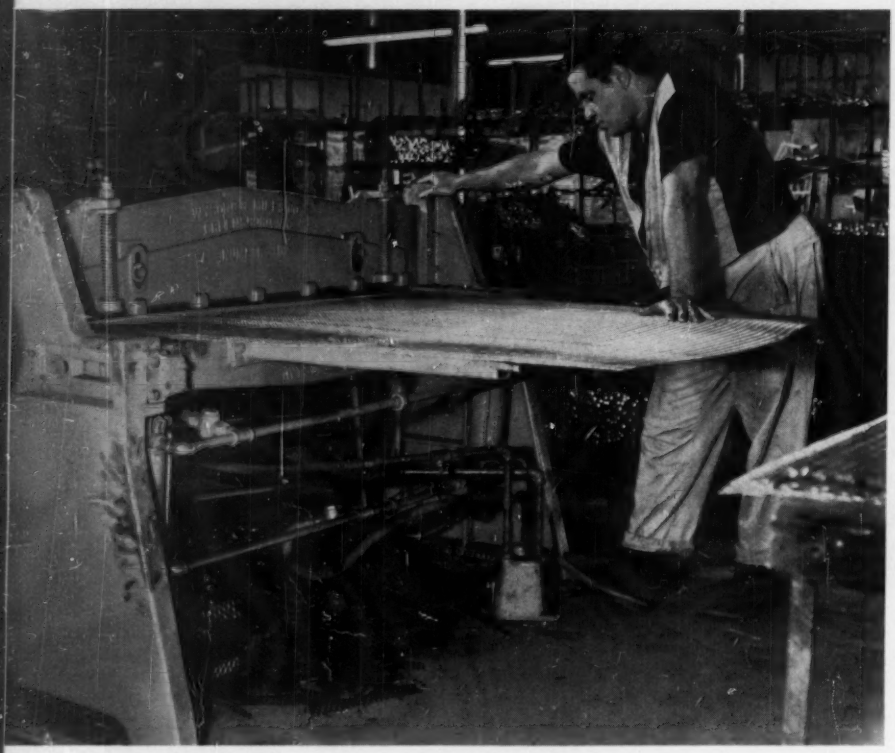
"Other wrought iron furniture manufacturers assured us this (compressed air) wouldn't work," stated co-founder Louis Baloff. "They said it wouldn't bend solid steel in a way we wanted it bent. But I was sure it would . . . so I made a bender and equipped it to operate by air power. And it does work perfectly."

This was the start of the business, almost a hobby for Baloff and his partner Samuel Mack. After building furniture for their own homes, they made some for neighbors. This was soon followed with orders from a store or two. Today, 10 years after its start, the firm is distributing its product internationally. It has become one of America's foremost wrought iron furniture manufacturers and has done much to move the product from outdoors into indoor living areas.

The transformation of a length of hot-rolled steel into a graceful, comfortable, durable chair begins in the versatile



THE BEGINNING The worker inserts a length of $^{1}/_{2}$-inch steel rod, precut to the correct size, into a Hossfeld bender, operated through a 21 x $3^{1}/_{2}$-inch Hanna air cylinder. It makes radius bends, 12 to 72 inches in diameter. As the rod is bent, it is moved forward until the desired curve is achieved. Unbent rods are in the foreground (left).



BACKS AND SEATS Here a wrought iron furniture worker shears the flat and expanded metal for backs and seats of chairs and chaise lounges. The 4- x 10-inch air cylinder is under the metal being sheared, just above the operator's foot.

mind of designer Baloff. All the partners ask of each new design is that it have certain styling and color now connoted by the word "Florida," that it be rustproof and durable, and that it "sells." Once they have ascertained these qualities, the chair and its companion pieces —tables, lounges and sofas—go into production.

In one end of the factory are big doors. Lengths of steel roll in by the truckful and are stocked nearby. Appropriate lengths of metal are selected and fixed in vises ready for cutting. A saw, advanced by compressed air operating through a Meade cylinder, cuts the metal. Then the pieces move along an assembly line to another jig. Here they are fixed in place and pneumatically bent to the desired shape—air power being supplied through a 5- x 13-inch Meade air cylinder in an operation that takes less time to do than describe.

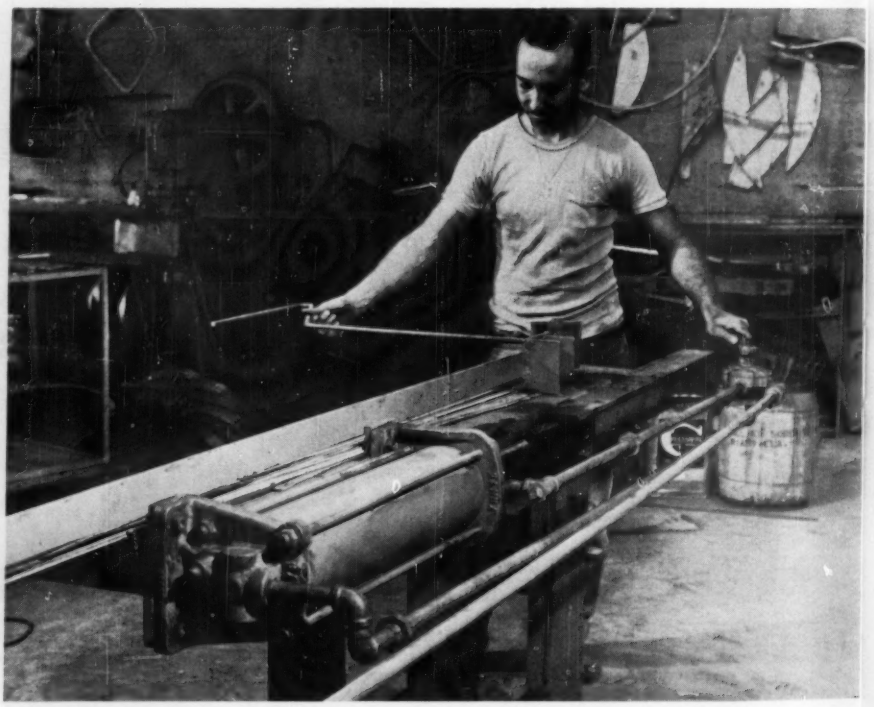
"We have worked out many such benders," Baloff continued, "so that we can bend steel into any shape we wish, rounded or angular." Usually the steel is bent at right angles to form the seats and backs of a chair. It is rounded for the arms. "I developed our first bender .... (Those) in use in our factory today are elaborations of that."

In another step, a saw pneumatically bites the superfluous metal from the corners of the chair seat, giving it the appearance of being mitered. A welder puts the pieces of the chair together, and the welds are sanded down by hand.

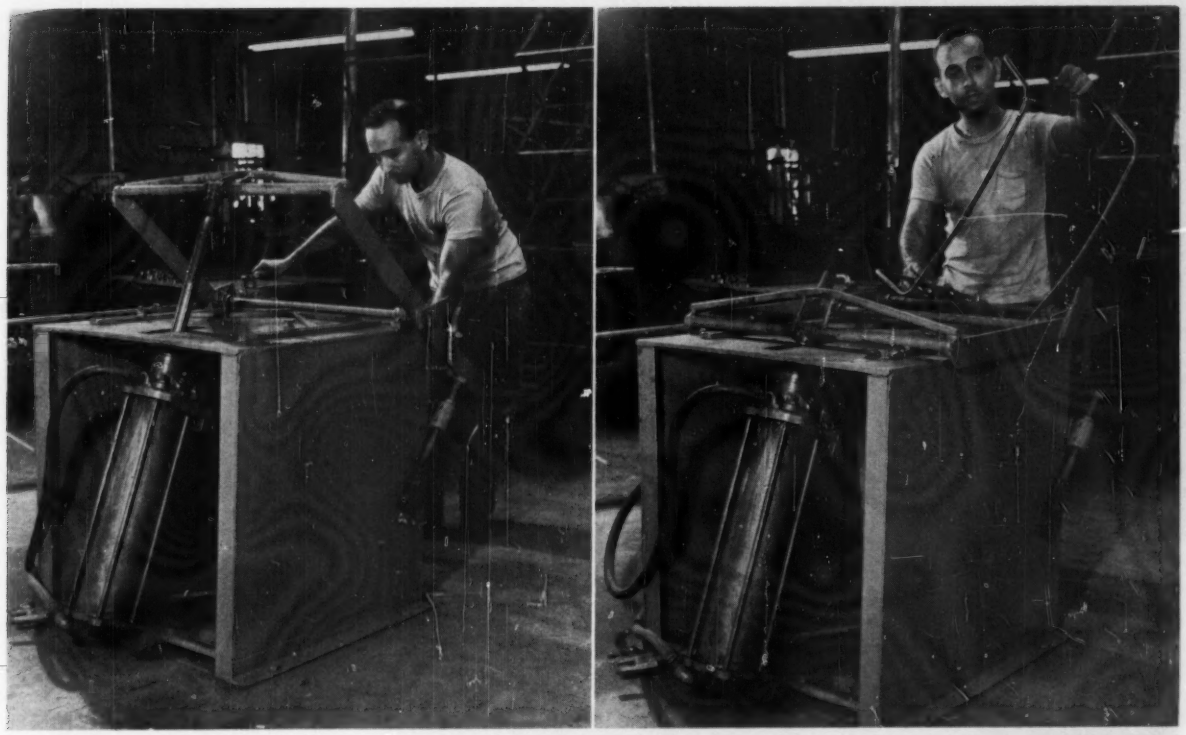
The chair is now ready for cleaning. A sandstorm of triangular grit, forced under high pressure, assaults the chair, freeing it of all scale and rust. Then aluminum, melted by heat generated by oxygen and acetylene, is mixed with compressed air and sprayed on the frame. It hits the chair with such force it penetrates the iron to a degree. This forms a rustproof covering over the entire surface. Da Vinci calls it "alumasealing."

Next the cleaned and aluminum-coated chair frame is dipped into a vat of undercoating to seal the surface and prepare it for the final painting. A color—perhaps persimmon, perhaps hyacinth—is sprayed over the frame. Finished chairs, sofas, tables and lounges are painted in colors that range from a pale "Bengal orchid" to a "Bermuda yellow," from antique white to black. All are suggestive of romantic isles and southern seas. Furthermore the da Vinci furniture is ornamented with cast aluminum scrolls in lacy Grecian designs or floral patterns featuring the Florida Hibiscus. Even with this high styling, as is clearly evident in the picture on the preceeding page, the furniture is engineered for comfort.

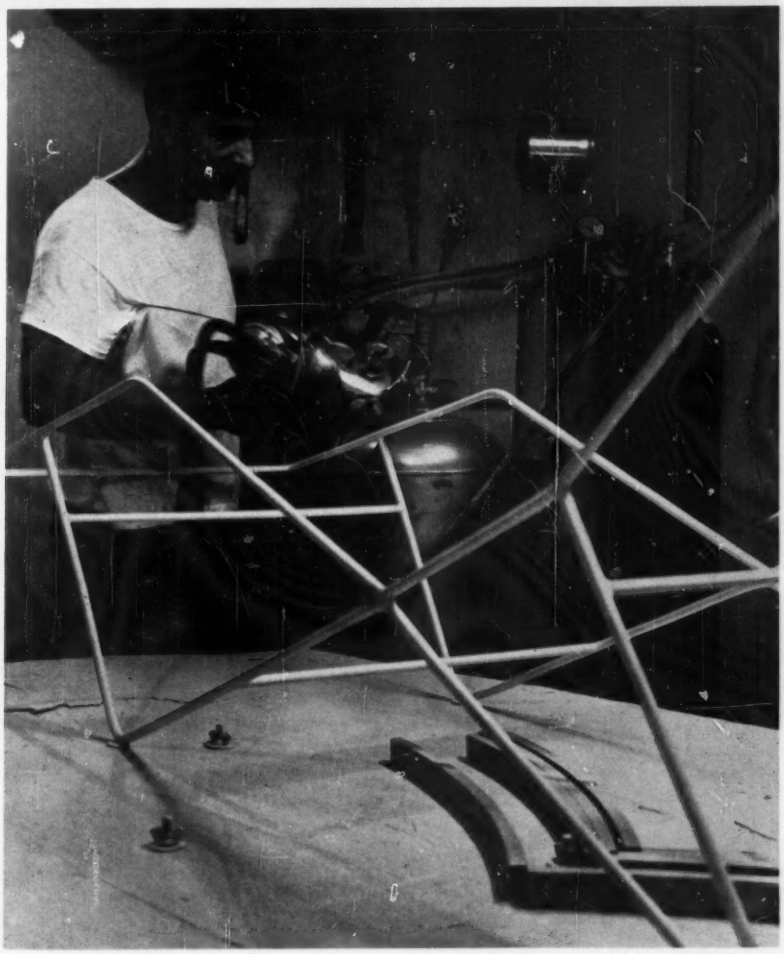
Now the chair is ready for its upholstered cushion. As the frame was moving through the production steps, the cushion was being made in another department. Even here, air power plays an important role running such devices as a grommet machine. Finally the completed chair stands ready for shipment anywhere in the free world.



LEGS chair leg gear. A cylinder causes th ing die f center sh



ARMS This Baloff-designed machine forms two arms at once. It is shown in closed position (left) before rectangular steel rods are inserted. At right, the cylinder has forced the lever up and the material into the bent position. The rods are welded only in one place.



LEGS A hairpin bender creates a chair leg. It has a rack-and-pinion gear. As the 23x5-inch Hanna air cylinder moves forward, the rack gear causes the pinion to revolve. A bending die forces the material around the center shaft making the bend.

ALUMASEALING The rustproofing process is important for outdoor furniture. Aluminum wire is melted by oxygen and acetylene gases and is then forced into a gun by compressed air, shown here held by the operator. It is ejected as a spray and is driven into the surface of the metal while it is still hot, making it rustproof. The chair then moves to a cleaning booth and finally to the painting operation.


MANNIX
BUILDING
A RAILROAD
NORTH TO
NOWHERE

THIS is the last in a series of three articles describing Quebec Cartier Mining Company's iron ore venture in Canada's Labrador Trough. Earlier articles described readying the mine for production, and construction of the necessary port for shipping the ore. This month's piece deals with the building of a railroad for hauling the ore from mine to dock.

Eric LeBourdais

NATURE seems to feel this way: if man has the subtlety to fashion an element to his needs, then first let him find a way to move its ore to his mills. When the geologists of Quebec Cartier Mining Company staked out that company's iron ore claims some 140 miles north of the St. Lawrence River's gaping mouth, they knew the ore was there in abundance. But when they mulled over the fact that the iron had to be removed, they solemnly faced south, squinted at the craggy terrain, and winced. Hauling out the ore wouldn't be easy.

After the geologists had finished, the company's engineers solved part of the problem by the nature of the operation they designed. A huge beneficiating plant—the largest in the world—has been built. Each year it will swallow some 20,000,000 cubic yards of rock. This will be concentrated and emerge as 8,000,000 cubic yards of ore, so only this amount will have to be shipped out.

The engineers also saw that, in addition to the work at the mine and at Port Cartier, another giant construction project would be needed: a railroad from the mine down to the port on the river's blustery north shore.

Between Lac Jeannine, the site of the mine, and Port Cartier lies some of the roughest terrain in North America. If one draws a straight line on a map between the two, the distance comes to 140 miles. In spite of tunnels and mammoth cuts and fills designed to keep curves and grades to a minimum, the railroad between the two will be 193 miles long.

Pitts-Foley (a joint venture between C. A. Pitts General Contractor Ltd., Toronto, Ont., and Foley Brothers Inc., Pleasantville, N. Y.) is the contractor for the project. Scheduled for completion yet this year, it will cost nearly $50 million. The completed railway will operate at about the same rate the year round since it is expected that ships will be able to load at Port Cartier all through the winter. Before mine start-up, the contractor must have moved more than 13,500,000 cubic yards of material; 4,000,000 cubic yards of this is hard pre-Cambrian rock.

But figures in the millions are not easy to visualize and scarcely reflect the concentration of men and equipment that has poured in to meet the deadline. At its peak, the Pitts-Foley payroll last summer reached nearly 2000; other contractors on the railroad had close to 700 men; and the consulting engineering staff ran to more than 300. The other contractors include Temiskaming Inspiration Ltd., which is driving the five tunnels; Arbec-Campbell Ltd., in charge of building the 17 bridge substructures; and Dominion Bridge Company Ltd., erecting bridge superstructures. Consulting engineers are Tippetts, Abbett, McCarthy & Stratton, and assistant consulting engineers are Cartier, Cote & Piette. The selection of the railway route was a difficult matter in which aerial photography played an important role. Canadian Aero Services Ltd. has been responsible for all layout, measurement and survey work.

Like any construction job in a remote,

CRAWL-IR CLINGS TO "CANYON."

FAR ABOVE RIVER AND ACCESS ROAD, CABLES HOLD DRILL TO ANOTHER "CANYON" LEDGE. TUNNEL APPEARS AT REAR.

ALONG 193 MILES OF RUGGED TERRAIN, WATER IS CROSSED 17 TIMES. AT RIGHT, A SPAN IS FLOATED INTO PLACE

rugged region this one has its unique problems. For instance there is the question of reaching the work areas. Much of the railroad's right-of-way is accessible from an expedient, dirt-and-gravel truck road that leads up to Lac Jeannine. Except for a little high-priority air travel, this road has served as the single artery to the outside world. Where the access road veers away from the railroad alignment, the contractor has had to carve out his own tote routes. Often this is a matter of working up the side of nearly vertical cliffs.

To the men who, in the early 1950's, built a railroad between Seven Islands and Schefferville for the Iron Ore Company of Canada, to even *have* an access road may seem a luxury. As part of the first ore development in the area they threw up a railroad approximately twice as long as the Pitts-Foley line (*see map*). Paradoxically, however, the Pitts-Foley crews have found their access road to be nearly as much of a hindrance as an advantage. Part of the contract calls for full-time maintenance of the road to allow for daily passage of truck convoys and other traffic to the mine and the town of Gagnon at the top of the line. The result is that with the railroad right-of-way paralleling the access route, and in many places superimposed on it, the contractors have had to be extremely careful in blasting and rock handling. This means extra care even with simple scaling for a mere stone falling several hundred feet can kill a man or do tremendous damage to equipment. The highway must not be obstructed for more than a short period. Sometimes traffic is stopped so that work can proceed, then often the reverse takes place as workmen stop to let the vehicles pass. Sometimes in blasting away cliff faces it is impossible to avoid burying the road. The shot is fired and the rock thunders down. Then the construction machinery clears the rubble to resurrect the route.

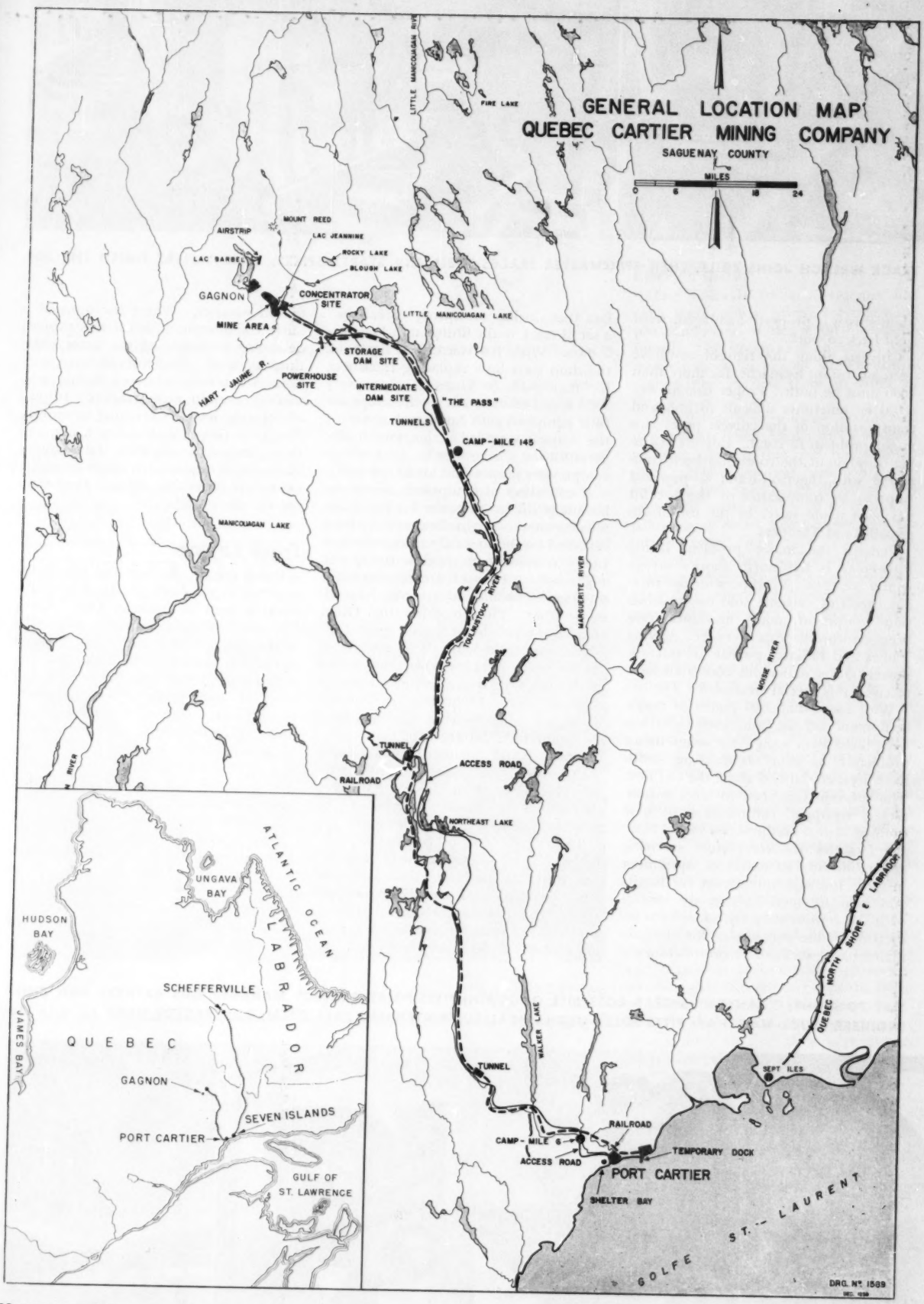
Some of the hills along the access road are too steep for the trucks, and heavy loads aggrevate the problem. To keep the truck convoys moving, the contractor has to station bulldozers at the bottom of steep inclines to act as tow vehicles. And when a truck grinds to a halt because of a breakdown, the contractor is again called upon to help. Such procedures are only logical for the situation, but highly perplexing to construction men who have a tight schedule to keep.

The most precipitous section of the highway is at Mile 150 at a site called the "Canyon." As one drives along the narrow, twisting access road, he hugs the side of a deep valley cut by a swift river. Overhead he hears the occasional staccato rattle of rock drills. Looking up carefully he sees small black dots on the cliff sides. These are Ingersoll-Rand Crawl-IR drills and their operators, working in places where it would seem impossible to drill. The job they are doing has played an important part in maintaining the progress of the contract.

Pitts-Foley has 34 of the machines sprinkled all along the railroad right-of-way, but the main concentration at this time is in the "Canyon," where 20 of them cling to the rock walls. Here it is difficult enough for men to climb up to drilling position, let alone raise machines. By attaching utility hoists or tuggers to the frames of the Crawl-IR's, hooking the wires to stumps and rocks up top, and using the drills' own track power, the drill operators have been able to scale nearly perpendicular faces. At times the men have had to attach two tuggers to raise a machine. Had the drills no "climbing" ability of their own, smaller and slower wagon drills would have had to be used. In spite of difficult conditions, the 34 Crawl-IR's have been keeping the powder men busy loading about half a million pounds of explosives every month.

Mechanical supervisor Paul Crum gives much of the credit for the performance of the Crawl-IR drills to their operators. Even when the temperature has dropped to 40 below, these men have remained huddled by their machines hour after hour in cold winds and clouds of drill dust. In the summer they have swatted vainly at hordes of black flies and mosquitoes. As an example of the drillers' hardy nature, there is the story of one who unthinkingly stepped back from his work—and plummeted 60 feet to a ledge below. Because nobody could reach him on the shelf, a helicopter had to be flown in to rescue him. He suffered only a cracked rib and

34 CRAWL-IR'S SCATTERED ALONG THE PROJECT DRILL HOLES FOR A HALF-MILLION POUNDS OF POWDER MONTHLY.



stockholders, involving principally Daniel Guggenheim, his brothers, the Whit-

TRACK WRENCH JOINS RAILS, THEN SPIKEMASTER SPACES THEM AND STARTS SPIKES; SPIKE DRIVERS FINISH THE JOB.

when this was properly bandaged, went right back to work.

Culverts along the right-of-way have been a constant headache, for more than 1000 must be built. Proper backfill material is sometimes difficult to find and transportation of the culvert pipes is a major problem in itself. Culvert assembly throughout the route has been completed with Ingersoll-Rand air-powered Impactools; compaction of the backfill has been made easier by the use of Ingersoll-Rand Tampers.

Perhaps the major problem facing Pitts-Foley is the north shore's savage winter weather. To cope with the ruinous effects of extreme cold on construction equipment, many machines have been reinforced with T-1 steel. Swing frames and radiator guards on tractors, shovel bucket doors and booms all have received this special treatment.

With more than 600 pieces of major equipment on the job, Pitts-Foley has been faced with a gigantic maintenance problem. As many as six line camps have been established along the rail line. The solution has been to erect a completely equipped central shop at base camp at Mile 6 on the access road. Here are facilities for completely servicing and rebuilding all makes of equipment in use. Job superintendents, mechanics and field foremen have ready contact with the central shop by radio. An indication of the necessity of the 600-man maintenance staff can be gained from the fact that during the spring "break-up," a set of truck brake linings may last only 2 days. With 100 tractors in the field, the shop stays busy replacing track sets, for they must be changed after every 2000 hours of use. All of the shops are fully equipped with Impactools. Air for the shops is supplied throughout by Ingersoll-Rand compressors. Portable compressors supply drill air in the field.

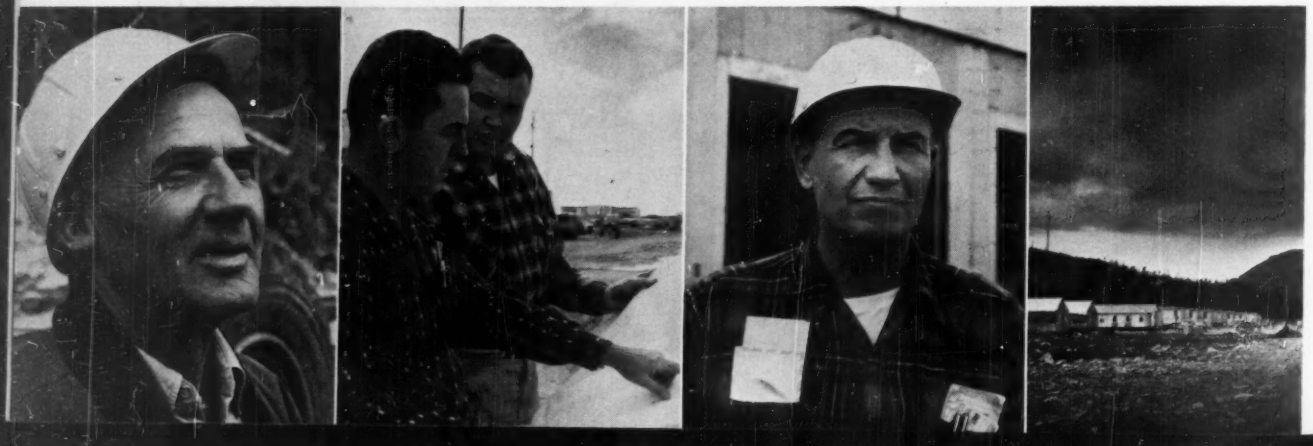
A collection of equipment accessories has made life much easier for the maintenance crews. Engine heaters have been installed on the shovels, trucks and other heavy equipment for quick warm-up and night use. All shovels are air-controlled and employ alcohol injection in the coldest weather. Pitts-Foley installed Onan alternator-type belt-driven generators, which run off the main diesel engines of the various machines when the shovel generators have trouble with starting in cold weather. Frequently overloaded when supplying working light at night, the generators have required little maintenance. Cold weather caused havoc with outside gear greases. It took considerable research to find a lubricant that would stay on the gears when the weather dropped below −20° F.

Though the job of constructing the railroad is an enormous one, planning and organization have eliminated nuisance problems and work has proceeded with a minimum of trouble. As a result of good winter preparation, for example, only 3 days have been lost due to bad weather. Where the unusual is fairly commonplace, as on this project, deliberate breaking of the rules sometimes pays off. The workers have occasionally run into light rock during common excavation with scrapers. Instead of delaying work by bringing in shovels, they have simply shot the rock fine and then mucked it out with the scrapers. Though this treatment is rough on equipment it is faster and cheaper than waiting for the shovels.

Track Laying

Following on the heels of Pitts-Foley to actually put down the track is a fast-working crew of Mannix Ltd. About 450 men have been amassed to lay rails at the rate of 7000 feet daily. Special equipment has played an important role in this high production. A complete rail handling and welding station, where two 39-foot lengths are joined into a single rail, has been set up at the harbor. Mannix adapted a Railway Maintenance Corporation rail-handling machine to install the long sections. Hand-held I-R Spike Drivers are used along with a Track Wrench to secure the rails in place. A Spikemaster stops at about 10-foot intervals, then lines up the track and drives four spikes at a time. Next come two Spike Drivers that pound in all remaining spikes. Ballast for the railroad is being produced by Mannix in a plant on the job.

LEFT TO RIGHT: "CANYON" SPREAD BOSS BILL GOODWIN; PITTS-FOLEY PROJECT MANAGER GUS RATHERT AND CHIEF ENGINEER BRUCE MAGAHAY; PITTS-FOLEY MECHANICAL SUPERINTENDENT PAUL CRUM; CONTRACTOR CAMP AT MILE 150.



QUONDAM BONANZA

S. M. Parkhill

IMAGINE sitting down to lunch in Alaska. It is Sunday July 22, 1900, and you are a prospector with a sprained ankle. The area is the Upper Chitina River, 200 miles east of Anchorage and about the same distance north of the coastal town of Cordova. While eating, you look up. Ahead is a green patch that looks like grass on the side of the Wrangell Mountains beside the Kennicott Glacier. Having just found a stone that appears to be almost pure copper in a nearby milky glacial creek, an investigation seems justifiable. What you find is not a pasture for sheep, but a rich copper deposit—and you are John H. (Jack) Smith.

At this point, Jack Smith, better known as the Arizona Centipede from previous trampings, turned to his partner, Clarence L. Warner, and said:

"By God, Warner, she's a bonanza!" Thus was found and named what proved to be one of the richest copper mines in the world. It was the beginning of Kennecott Copper Corporation, named for the Kennicott Glacier, but misspelled through a clerical error. The company was formed in 1915 as the result of Wall Street conferences among Guggenex stockholders, involving principally Daniel Guggenheim, his brothers, the Whitneys and Thomas Fortune Ryan. Its formation is one of the most fascinating in stock market history and is a partial picture of the building of one of America's great philanthropic fortunes.

Warner and Smith were working in partnership with eleven other prospectors and twenty-one men who had furnished them grubstakes. They returned to the group with their astonishing story of copper.

THE BONANZA MINE

About the Pictures

The Bonanza discovery caused quite a stir both in mining and investment circles. Yet during the time it was being worked, very few photographs could be taken. It is said that Stephen Birch, "the Simon Legree of Kennecott," allowed no unauthorized person on the property for any reason—especially to take pictures. *Compressed Air Magazine* is fortunate in having the president of Grays Harbor Equipment Company as one of its readers. In 1910 this reader, Robert F. Isaacson, was prospecting in Alaska and managed to take a set of pictures of the original Bonanza lode and surrounding territory. He has lent them to us, and they are reproduced on these pages.

Early Finds

The Thlinkit Indians evidently had early used copper (*chiti*), for many implements made of the metal have been found. The Indians are known to have covered sheets of copper with heraldric designs and carried them in front of their chiefs.

The Russians were aware of the copper deposits when Alaska was a Russian territory, though they did not develop them. Native law was based on a life-for-a-life principle. The Russians had murdered many natives in their stay in Alaska and dared not venture too far inland away from their forts. Yet, Aleksandr Andreevich Baranof, first manager of the Russian-American Company that controlled Alaska before her purchase by the U. S. in 1867, collected copper from the Indians. Indeed, a 203-pound copper bell was cast for an Orthodox Russian church, and the machinery on the gunboat *Politofsky* was made of the metal, reputedly at a cost greater than that for the rest of the ship.

In 1898 a band of argonauts discovered the ore in the Copper River district while on their way to Dawson, B. C. Eventually copper was found at Chitina River, a tributary of the Copper River, and at the head of the White River. The metal discovered by Warner and Smith at the source of the Copper River was not made available until 1911.

The earliest mining that yielded significant amounts of minerals began in 1880. It was hampered by remoteness, lack of extensive transportation facilities and high cost of operation. Notwithstanding this and the fact that the price of copper was low, Alaska's copper industry grew meteorically, for deposits were unique in that they were abnormally high-grade lodes of sufficient size to warrant exploitation.

Interesting Capital

A young, brusque mining engineer and recent graduate of the Columbia School of Mines, Stephen Birch, was in the territory seeking claims for New York City investors when Warner and Smith returned with their copper tale. He overheard the story while drinking a glass of whisky and offered to inspect the

deposit for possible purchase. Seeing the untapped wealth of the Bonanza, he took an option on the claim and returned to his New York headquarters to obtain capital for development work. He estimated that copper could be taken out for about $0.05 a pound (mining costs amounting to approximately $0.0225 a pound; the balance, transportation charges) and would sell for $0.12 to $0.20 a pound. The Guggenheims and the banking house of J. P. Morgan & Company furnished the necessary money; The Chitina Exploration Company was established to take over the claims of the eleven prospectors and their backers.

Unlike gold, copper is too expensive for individuals to mine. In this case, it had to be hauled out of Alaska for smelting in Tacoma, Wash. Furthermore, a sack of gold might be worth thousands of dollars; 100 pounds of copper would be worth only, say, $10. The Alaska Syndicate, a closed corporation composed of Daniel Guggenheim (who held a quarter interest), Jacob Schliff of Kuhn-Loeb, and George W. Perkins of the Morgan banking house, and whose managing director was the tall Stephen Birch, had interest in practically all the industry of Alaska. It was able to finance such a project, and did so through The Chitina Exploration Company.

Unfortunately when news about the value of the copper lode leaked out, many earlier prospectors claimed rights to the Bonanza. The case was taken to court. Not interested in investing money in a mine that might belong to others, the Morgan-Guggenheim Syndicate delayed its exploitation. The mine was in litigation until 1906, at which time the Supreme Court decided in favor of Warner and Smith. The Syndicate completed the purchase and proceeded to build a 200-mile railroad into the area and develop the mine.

Wilderness Engineering

Building the Copper River & Northwestern railroad was no easy task. It had to be put through mud bogs. Glaciers had to be conquered, and rushing streams and canyons had to be bridged. The roadbed had to be blasted out of solid rock in many places. Men worked for $3 a day, from which they paid $1 for a night's sleep and $0.50 a meal. The temperature often fell to 50° below zero. Construction began in 1906. By 1911, 196 miles had been laid at a cost of about $100,000 per mile, even though no profits were yet being realized from the Bonanza Mine.

An instance of the engineering skill required in the construction was the bridging of a river between Miles and Childs glaciers. Piles were driven into the river bed through 7 feet of ice.

BONANZA SLIDE BEFORE BEING DISTURBED

KENNICOTT GLACIER

MOTHER LODE MOUNTAIN

There was a dash to finish the third and last span before the thaw, but the ice began to move, carrying the uncompleted span with it. One work gang chopped the ice with all manner of instruments; another melted it with steam pipes; a third crew inched the ice back with block and tackle. The bridge span was eventually brought back into position, riveted and bolted in place. Eighty-pound rails were positioned 1 foot apart in front of each pier as an ice breaker. The bridge is said to have cost about $1,500,000.

Railroad Towns

One terminal of the railroad was on the coast; the other was McCarthy—a town that once thrived with some 3000 people who worked the Kennecott mines 7 miles away.

Further down the line, at the point where the railroad and Copper River diverge, is Chitina. It is now a ghost town, but was once a booming trade center. Today there are 25 people, including children, living in Chitina. You can still order a drink standing at a vintage mahogany bar, lined along the front with brass cuspidors and beside an old piano. Commercial Hotel in Chitina is falling apart and is called Spooks Nook. The town has a newspaper too—the mimeographed *Ghost Town Gazette*. The people who are there now live chiefly on salmon and game, and make their money from trapping. All hope one day to see a revival of copper mining, or new prosperity when the Cordova Highway is built through their village to connect with Edgerton.

Mine Development

While the railroad was being constructed, supplies were sledded in over snow and ice to the mine so development could begin, even though the ore could not be shipped to the smelters until the railroad was finished. Among the equipment taken into the area was an Ingersoll-Sergeant compressor, probably of the XB-2 type, pneumatic tools and a water-Leyner drill.

The main mine drill was a stoper known as the BCR-61. It was, in effect, a BCRW-430 Jackhamer modified with an air feed, and of course a rotating front head. Water was supplied through the drill and drill steel to the face of the bit. The enginers at the Bonanza tried many different stopers in the ore, particularly in the high-grade which occurred in large blocks of solid C2s. The so-called low-grade ore ran about 8- to 12-percent copper and did not present a serious drilling problem. The top grade was not very hard, however it was very dense. An ordinary stoper such as the CC-11, which was a hand rotated stoper, and the CC-110W1, which was a water machine, as well as other units, were too powerful. They generated so much heat at the bit that the copper actually fused out of the ore in the face of the hole. The BCR-61 hit hard enough so that the drillers could get a hole down in the high-grade ore after a fashion. By feeding a constant stream of water under air pressure from water tanks, they were able to finish their blast holes. The only thing required was patience because it was rather slow going.

Drill steels had to be carried to and from the blacksmith's forge for sharpening. Moisture in the air lines constantly froze, even during the warm summer months. With all these problems and early equipment, the mine began producing. It was served by an aerial tram from the mill which was located at the rail head at Kennecott. (Kennecott is located on one of the low bridges bordering the Kennicott Glacier.) There was approximately 3000 feet difference in elevation between the mill at Kennecott and the mine; the tramway was about $3^1/_2$ miles long.

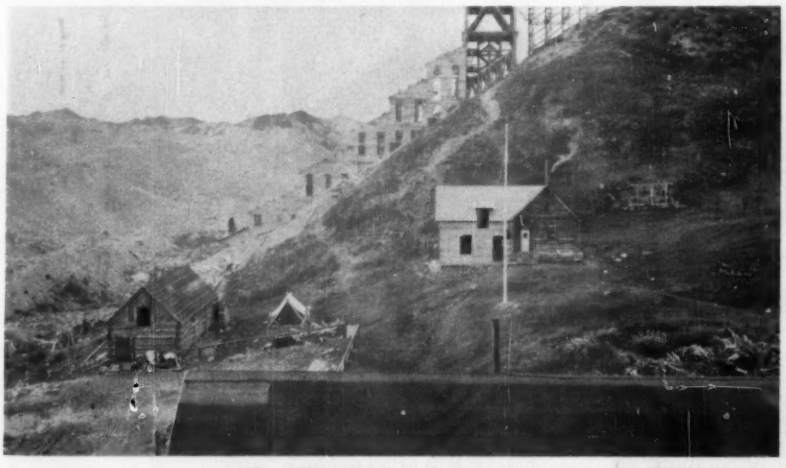
When the last spike (appropriately fashioned of Kennecott copper) was driven, the first trainload of ore was ready for shipment. It assayed at 75-percent copper, and each gondola carried $12,000 to $15,000 worth.

By the end of 1912, Kennecott paid $3,000,000 in dividends—only a taste of what was to come. In the early years of the Bonanza Mine, sales of 1000 to 1500 shares every half hour kept ticker tapes busy. The stock was selling for about $150 a share, although at times it reached as high as $162. The mine was profitable for its investors. In a single week in 1916, six ships left Cordova, dubbed Guggenheimburg, the port of entry for the Kennecott mines. They sailed to the Tacoma smelters with copper ore valued at $7,200,000—the price paid for Alaska in 1867.

The mine operated from 1911 to 1938, at which time it was closed because the ore was exhausted. The railroad also ended operation, its last scrap steel being sold in 1952. Bonanza had been the richest of copper mines. At the time the copper was put on the eastern U. S. markets, the cost was about $0.07 per pound; the market was running between $0.28 and $0.30 per pound during World War I years.

Geological Quandry

The Bonanza posed an interesting question in geology: why did this igneous copper, a primary enrichment, occur in a secondary (sedimentary limestone) formation? "Copper Resources of Alaska," in *Copper Resources of the World* (published 1935), offers two possibilities: "The copper was derived from the Nikolai greenstone through leaching by meteoric waters of the deeper circulation, heated and perhaps charged with magmatic products by contact with underlying bodies of hot intrusive rocks," and ". . . derived directly from magmatic solutions, discharged from underlying magmas in the course of intrusion, the magma being either basic and related to the Nikolai greenstone, perhaps as the underlying reservoir that supplied the basaltic flows, or else granodioritic." In absence of proof of either hypothesis the book goes on to say "it seems best at present to regard the source of the copper in the lodes as an open question. The solutions that deposited the copper may have been either of magmatic origin or of atmospheric origin and heated by contact with bodies of hot intrusive rocks, but it is believed that, irrespective of the original source of the copper, the deposits were formed by heated water, migrating upward and being therefore classifiable in effect, at least, as hypogene solutions."



TRAM TERMINAL AND CONCENTRATOR AT BONANZA MINE

Drive for Power at Niagara

R. J. Nemmers

WITH THE first power scheduled to flow from the $750 million Niagara River Power Development project, Niagara Falls, N. Y., by February 10, contractors on the mammoth project—which will include the world's largest power plant—are pushing along at a rapid pace. The design details of the job, which will claim the United States' share of the vast power potential of the Niagara River, were covered in the January 1959 issue of *Compressed Air Magazine*. Briefly, the system will work by transporting water from above the falls through two cut-and-cover conduits, each almost 4 miles in length, to a forebay area some distance below the cataract. Water in the forebay will then plunge 376 feet through the Lewiston Powerhouse penstocks to its giant turbines. The thirteen turbine-generators will each be rated at 200,000 hp with a total capacity of 1,950,000 kw.

When more water is available than needed for power production or to maintain required flows over the falls themselves, the excess will be pumped from the forebay into the Tuscarora Reservoir to be held until required. Tuscarora Pump/Powerhouse will incorporate twelve pump/turbine-motor/generator sets. As turbines and generators, each will have a capacity of 28,000 hp and 25,000 kva; as pumps and motors, the sets are to be rated at 3400 cfs and 37,500 hp.

Although work on the entire project is being pushed to completion as fast as possible, the big drive for Niagara's power is centered around the water courses. Two of the more interesting facets of the job are pictured here—the concreting of the giant water tubes and the sealing of the area around the permanent structures to contain the incredible amounts of water that soon will pour through them.

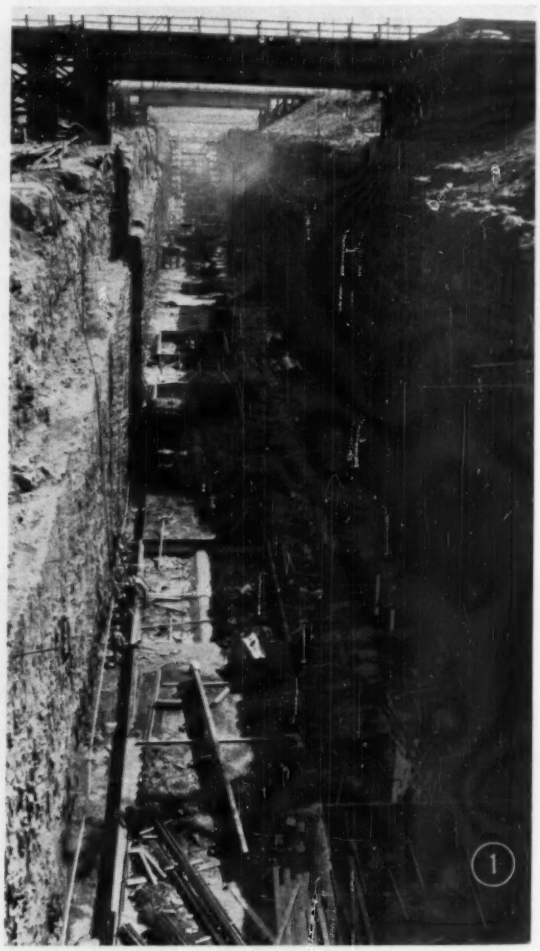
As an indication of the magnitude of the job, it can be noted that one subcontractor has underway or has completed $5,000,000 worth of work that has consisted primarily of rock drilling and grouting. Selby Drilling Corporation, a subsidiary of Morrison-Knudsen, assembled for that work an array of rock drilling and grouting equipment, along with the necessary portable compressors and auxiliaries, that would rival the equipment of many a general contractor on all but the largest of hard rock excavation jobs.

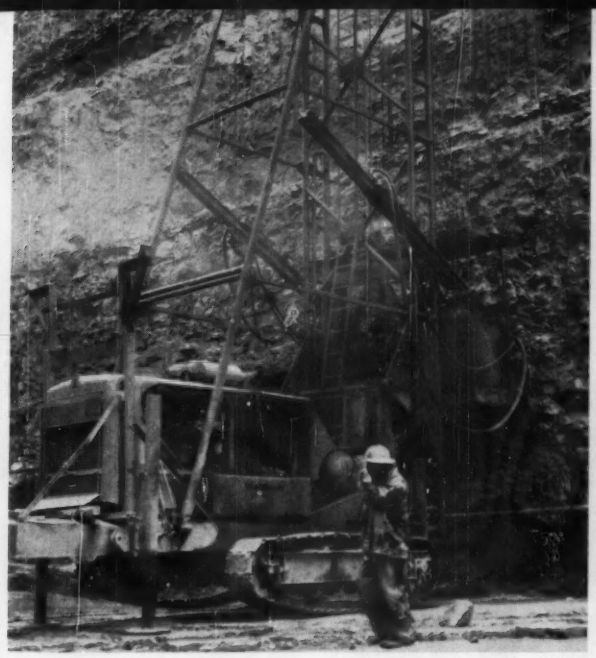
Presently at work on the Selby contracts are six CM-2 Crawl-IR drill mountings used interchangeably with D-45 drifters or with rotary grout hole drills. Three 900-cfm Gyro-Flo rotary portable compressors and one 600-cfm Gyro-Flo; four shop-built grout machines; four truck-mounted core drills; two flat-rack trucks, as well as five pickups; and one water tanker make up the remainder of the spread.

The Conduits

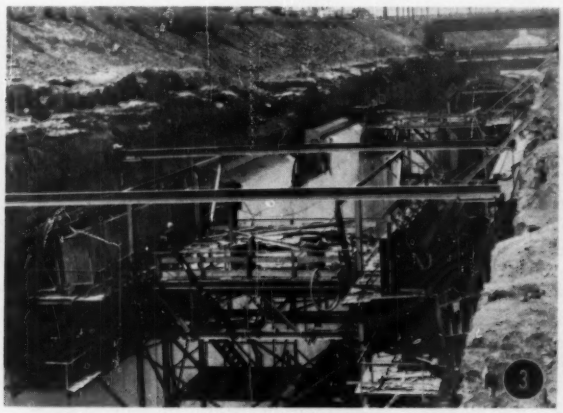
More than 16,500,000 cubic yards of rock came out of the 46-foot-wide trenches—most of it a so-called Lockport dolomite. The depth of the huge conduits has varied from 64 to 120 feet, and their bid cost has totalled $136 million. All the walls were carefully line-drilled with a variety of special drill rigs (*Compressed Air Magazine*, January 1959) to avoid shattering the surrounding rock.

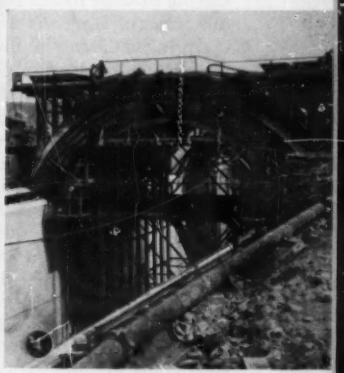
PINHOLING Two different types of drill rigs were put to work along the line of the conduits to drill anchor bolt holes to hold the concrete lining to the rock walls. One type is largely self-contained and self-propelled. It consists essentially of an Ingersoll-Rand Drillmaster carriage mounting a Gyro-Flo compressor. As shown in the view on the next page, a special carriage runs up and down between twin guides on the tower. The carriage mounts two drills secured at the required 30-degree angle to the face. Three-inch-diameter holes



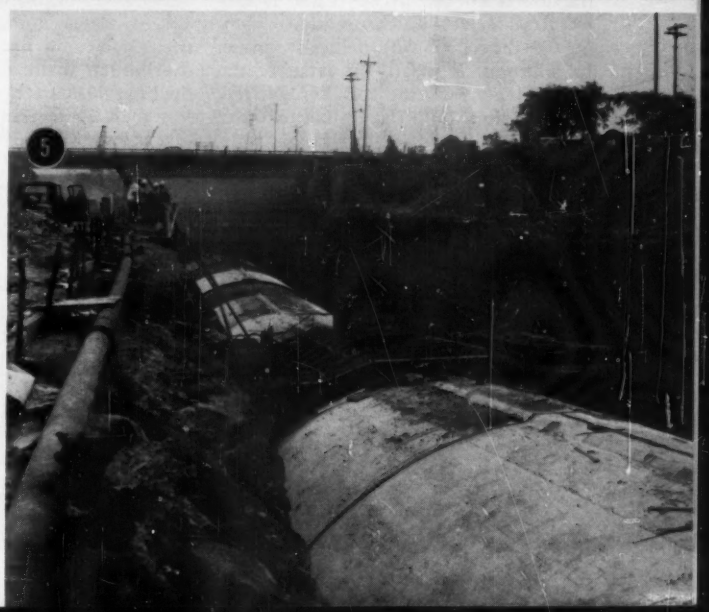


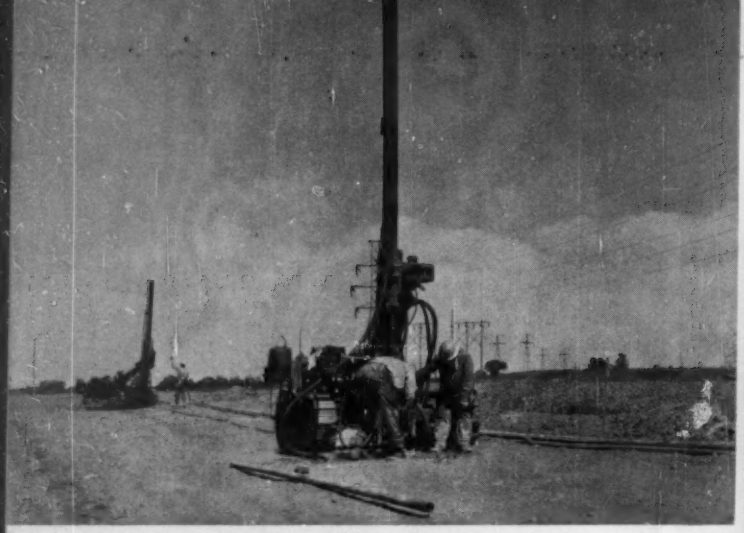
were drilled 8 feet deep and are spaced on 8-foot centers horizontally and 6-foot centers vertically, the top-most row being $40^1/_2$ feet from the floor of the trench. (The first row of holes is $4^1/_2$ feet from the bottom and was drilled out by crawler-mounted drills.) Three of these so-called pinhole rigs were at work on the conduits. Selby Drilling Corporation on a subcontract for Merritt-Chapman & Scott drilled out the 6000 feet of conduit on Work Section 1. Selby's two machines mounted D-45 drifters. Another machine mounting X-71 drifters was used by Gull-Defelice on its 5600 feet of conduit comprising Work Section 3. Balf-Savin-Winkleman used a similar basket on an independent tower arrangement (resembling pile driver leads) that was suspended from a crane on its 9000 feet comprising Work Section 2. Anchor-bolt holes in the floor were drilled as shown above where Crawl-IR's mounting D-45 drills are at work. As the 3-inch holes were bottomed out, reinforcing bars were slipped into place to form the "pin cushion" effect shown far left.

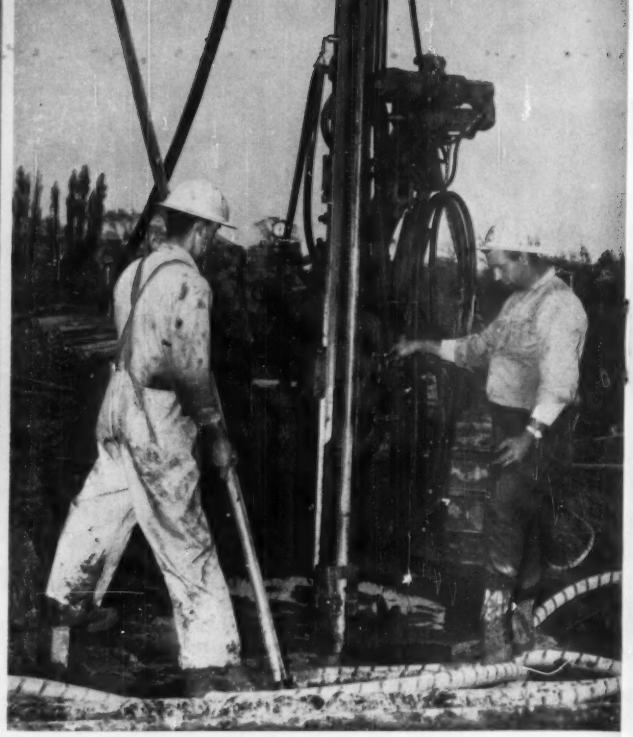




CONCRETING The five pictures in this group show in sequence the concreting operation. All three of the general contractors on the job are using essentially the same methods with similar equipment. Forms are supplied by Blaw-Knox. The floors are $2^1/_2$ feet thick; the walls a minimum of $2^1/_2$ feet thick widening out at the springing line to provide for a 6-foot-thick mass of concrete at the abutment. The cover concrete thickness varies from 6 feet to $4^1/_2$ feet at the crown. To prevent hydraulic pressure against the side walls, a piece of air-expandable Voidcrete rubber tube is suspended vertically at approximately 10-foot intervals along the walls. After concreting, the tube is deflated and withdrawn leaving the necessary drains. Dumbbell-shaped flexible seals are used in all concrete joints throughout the length of the conduit. Essentially the floors are poured first in a checkerboard pattern using alternate pours to speed operations (1). Then the side walls are built up in 40-foot-long blocks 22 feet in height (2). Air-powered winches aid in positioning some of the wall forms which are stripped after 3 days. Then haunch forms are placed and poured (3). Completing the arch calls for installing reinforcing steel over the arch forms (also 40 feet long) and then pouring some 500 cubic yards of concrete (4). Top forms are stripped in 3 days; the under forms remain in place to support the arch for 6 days. The completed conduit (5) will be covered with earth.







GROUT DRILLING Shown above are two of Selby's six Crawl-IR drill mountings working on the grout curtain stretching for 6½ miles around the Tuscarora reservoir. Holes are being put down on about 10-foot centers and average approximately 100 feet in depth. The unit in the foreground is equipped with a D-45 drifter and is used to drill through 10 to 20 feet of overburden and set a 2-inch pipe casing. The unit in the background is fitted with a rotary grout drill and is used for the remainder of the hole. All of the Selby Crawl-IR's have been fitted with the special rack, visible in both these views, which also mounts a piston-type water pump and necessary tools.

Grouting

Caving of large blocks of rock from along the Niagara Gorge is a not uncommon event in the history of the area. Perhaps the most widely reported however, was the one that destroyed the much smaller previous powerhouse on the United States' side of the river. Although a great many factors contribute to these rock falls, including undercutting by the river, one of the chief causes is the percolation of water through the surrounding rock. The tremendous head imposed on the underground waters by the falls is, of course, responsible for much of this saturation of the area's rock. Any location in which a small fracture is opened by any cause is subject to water flow and a resultant widening of the crack will naturally ensue. In addition, especially in some of the underlying strata, the rock is relatively soft and thus quite susceptible to water erosion.

To assure that the new project will be well protected from any caving or rock slippage so induced, an extensive grout curtain is being drilled into place around the major structures of the project. Selby Drilling has done or has contracts for the major portion of this work. On Work Section 1, Selby's subcontract for $1,300,000 calls for grouting the perimeter of the intake cofferdam as well as under the intake proper. Some 44,000 feet of drilling is called for by the contract, broken down as follows: overburden, 10,000 feet; core drilling, 4000 feet; and grout holes, 30,000 feet. About 60,000 sacks of cement (94 pounds each) were pumped into the grout pattern.

On the Tuscarora Reservoir, some 147,000 feet of drilling is being done by Selby under a more-than-$1,500,000 contract. The job includes 40,000 feet of overburden drilling, 5000 feet of core drilling, 90,000 feet of grout hole work less than 30 feet in depth, and 28,000 feet below 30 feet. An estimated 325,000 bags of cement will be pumped into the grout net.

Surrounding Lewiston Powerhouse will be an extensive grout curtain which extends 2000 feet north and south of the structure, plus 1000 feet on each side of the forebay canal. Selby has contracted for this work under terms of another more-than-$1,500,000 contract. Overburden drilling on this job totals 30,000 feet; core drilling, 9000 feet; and grout hole work, 280,000 feet. In addition the contract calls for the sinking of some 42,100 feet of drainage holes plus another 100 drain holes right in the powerhouse gallery totaling 24,000 feet. More than 100,000 bags of cement is the estimated quantity of grout required on the section.

Selby, under general superintendent Dick Kangas, has also contracted for the grout work around Tuscarora Pump Power station. This includes 1200 feet of core drilling, 22,300 feet of 2-inch grout holes, 4500 feet of 3-inch drainage holes and the placement of 22,000 sacks of cement.

AIR SUPPLY Selby's fleet of Gyro-Flo 900 portable compressors is shown here supplying air to grouting operations on the Tuscarora Reservoir. The operation stretches out roughly ½ mile in either direction of this battery. A total of 5000 feet of Naylor air pipe runs the length of the spread paralleled by a similar quantity of Naylor water pipe. On each shift, a crew spends 4 hours unloading bags of grout cement and the other 4 hours taking up and re-laying pipe to follow the fast-paced operation.

tages; testing and developmental work

Each month, some

pounds of hot sand had passed through

This and That

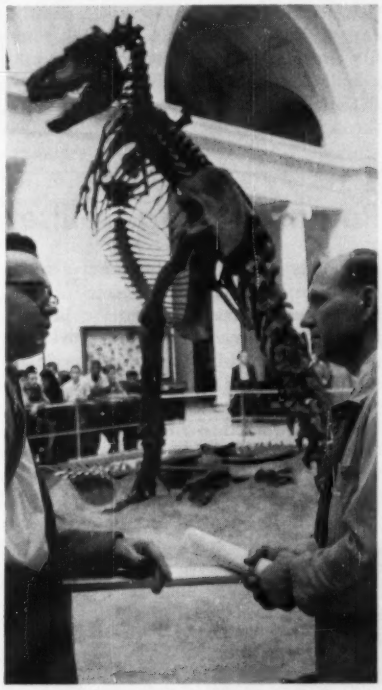
Suburbia Comes To Whiskeytown

The concept of split-level living is being used by the Bureau of Reclamation in designing fishery conservation features at Whiskeytown Dam, which is to be constructed on Clear Creek, a tributary of the Sacramento River, near Redding, Calif. The 2-level principle of the dam, however—as better befits the type of clientele to be served than it would in American Suburbia—has to do with water releases from behind the dam and involves warm and cold running water. On the upstream side there will be one outlet near the bottom of the dam for cold water and another near the top for warm water. Each leads to a control gate within the dam from which a single outlet will send water into the stream below. This is the first time such outlets have been specifically designed for temperature control for fish conservation. Since cold water has a greater density than warm water, the warmer will be at the top and the colder below. Thus, the top can be released through the upper outlet during the January–August season. Cold water can be retained for release from the lower outlet, 125 feet below, during the fall spawning season from September through December. This water conditioning will provide a healthier environment for salmon and steelhead trout that frequent the Sacramento River and Clear Creek. Optimum salmon spawning conditions, for instance, require a water temperature of about 55° F. By combining suitable proportions of releases from the two outlets, the desired temperature can be achieved downstream.

★ ★ ★

Strange Use For Steel

Perhaps few other industries are as uppermost in the minds of the men on the street as the steel industry. Yet, there are uses for steel that are not commonly thought about. One is illustrated in the accompanying picture. Looming behind Orville Gilpin (right), chief preparator of fossils at the Chicago Natural History Museum, and a representative of Joseph T. Ryerson & Son, Inc., a steel fabricating company also of Chicago, Ill., are the bones of the biggest animal ever to walk the earth. The brontosaurus skeleton weighs about 7 tons (a single neck vertebra, about 190 pounds) and stretches 72 feet from teeth to tip of tail. To support this beast, special steel members



had to be devised. The results were not only beneficial to the museum, but to the members of Ryerson. Their engineers say they are quickly becoming dinosaur experts after supplying the steel and technical assistance for this reconstruction and that of two other prehistoric monsters.

★ ★ ★

Air And Electric Angling

"Air Angling" in our June number reported about research during the past 3 years off the coast of Maine in catching herring with compressed air. The Maine sardines, as the herring are called when canned, can be directed toward seines and weirs with long curtains of compressed air bubbles from perforated hoses placed underwater. The most recent report from Keith A. Smith and his crew of Bureau of Commercial Fisheries researchers is that electricity is being used in conjunction with the bubbles. It seems fish are attracted by a charge that is induced into the water by an electrode trailing a boat. They move toward the electrode when it passes within about 10 feet of them. The fishes' affinity for an electric current has been known for a long time; the problem has been how to get the fish close to the electrode in the first place. The possibility is that the bubble veils will be used to direct the fish toward the charged area. A fish pump will be located next to the electrode and the attracted fish will simply be pumped aboard the vessel. If this system works out, fishing concerns will naturally be able to reduce their costs. Seines require many personnel and much time for handling, and are costly to buy and maintain. With the new arrangement, the traditional gear may be replaced by the compressed air and electric-charge equipment.

★ ★ ★

Milling Machines Afloat

Pressurized air bearings may find a highly useful application in automatic machine tools. The British National Engineering Laboratory, East Kilbridge, Glascow, Scotland, has found that air bearings greatly reduce the friction of servomotors and other control apparatus. This will permit the use of smaller components and cut the over-all cost of such controls. Besides achieving both lower static and dynamic friction, the units virtually eliminate wear because there is no metal-to-metal contact. Another advantage with far reaching implications is that the compressed air bearings require no oil circulation, hence no expensive equipment for this purpose. Further, there is no temperature rise during their use, allowing sustained high-speed and high rotational precision. Horizontal milling machine tests back up the claims: power needed to drive the worktable was cut a hundred times when the table ran on air bearings. One application on a milling machine used air bearings consisting of two brass strips drilled with a 0.02-inch holes at $1\frac{1}{2}$-inch intervals. Connected internally, the holes received an air supply of about 5 cfm at 600 psig. The table floated clear by 0.001 inch.

The Laboratory also reports that, in some cases, air can be used instead of water as the test fluid for developing new hydraulic machines. Such procedure offers economic and experimental advan-

tages; testing and developmental work on large pumps are possible cases. Water trials of very large units for example may be impractical because of high power and water needs. Air testing, due to the decrease in density, requires only about one eight-hundredths the power needed to supply the water. What's more, in the early stages of a pump's development, air permits the use of a pump that is inexpensive to make and easy to modify. Though the differences in the characteristics of the two fluids mean that air tests may not be truly representative of the water performance, a method of correlating the two can be applied.

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A Tire, Is A Tire, Is A Tire

Ever wonder why a tire is called a tire? According to The Goodyear Tire & Rubber Company, it was so named because it was "attire," or covering for a wheel. The highly developed pneumatic tire of today is much more than just a wheel covering, though. It is credited with translating power and handling potential into top highway performance.

Withstanding Mechanical Sandstorms

Each month, some 140,000 pounds of sand used for foundry cores is blown through ducts leading from drying units at the Elizabeth Street Foundry Company, Chicago, Ill. Temperature is 175° F. At two right-angle bends in the line, the vicious man-made sandstorm formerly cut through the $1/8$-inch mild steel ducting in about a month. To avoid frequent shutdowns for repair, special abrasion-resistant alloy steel wear plates were welded in the elbows. These lasted longer, but still required replacement after 2 months. Then Adiprene urethane rubber was tried. It has a combination of hardness, resilience, and load-bearing capacity, along with resistance to abrasion, oxygen, ozone, oils and grease. Wear plates fabricated from the $1/8$-inch sheet of Adiprene were bolted in and inspected periodically. At the end of 3 months, the report was "surface shine is not worn off." At the end of 6 months, after service life some five times that of mild steel and two and a half times that of the special alloy, the liner was finally found to be worn through. During the period, 840,000 pounds of hot sand had passed through the duct. Two to five shutdowns for repairs had been saved, plus the cost of welding steel plates to the elbows.

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Bird Watchers vs. Engineers

Bird watching and engineering may have neck craning in common, but there the similarity seems to cease—at least at the Ice Harbor lock and dam on the Snake River. When the concrete corners of the high spillway begin to look as if they were molding, the U. S. Army Corps of Engineers realizes the swallows are returning—and they are not as delighted as the tourists at Capistrano. The swallows' home-building traits are like those of cliff dwellers. They plaster their quasi-adobe hatching pens against a perpendicular concrete wall and proceed to add mud to mud until they have a pedestal-like homesite. The headache for the Engineers comes when they try to fit Ice Harbor's multiton steel taintor gate guides and sealers into the spillway channel grooves.

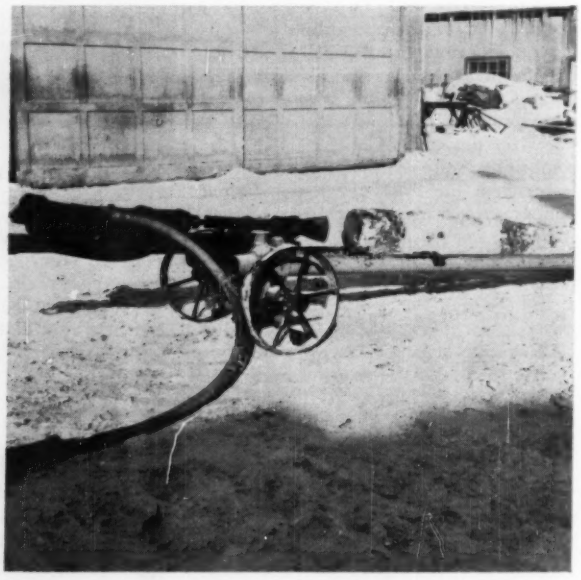
Pneumatic Log Splitter

LAST winter chief powerhouse operator Al Tripp, at Eldorado Mining & Refinery's Port Radium Mine in the Northwest Territories, became disgusted with the logs used to fire a wood-burning boiler. The timber was often gnarled and full of knots. Much of it wouldn't burn unless it were split, but taking an axe to the knots and bad grain was a startling vocabulary builder.

Tripp looked around to see what odds and ends he had at the lonely camp, then improvised. The result can be seen in the pictures. First he built a frame of $3\,1/2$-inch pipe and bolted it to a pair of steel wheels. On the axle he mounted an old Ingersoll-Rand DA-35 Drifter. A wedge was fashioned with a torch and welded to the shank of a 1-inch octagon drill steel. Pawls and springs were removed from the drifter's rifle bar.

For splitting, a log is placed on the cradle formed by the pipe. Metal straps from pipe to pipe actually hold it. The drifter drives the wedge into the log and about halfway in, the log splits, knots or no knots.

Our northerly correspondent adds that the technological-advance side-effect expected—the operator freezing because he no longer has to swing an axe—doesn't occur. He is too busy handling logs.



EDITORIAL

Man-Made Macromolecules

CURRENTLY in vogue, not only in chemical laboratories and plants, but in the home and in industry are some fascinating compounds that go collectively by a number of names. Chemists prefer to call them macromolecules or high polymers. We wear them, walk on them, ride on them and otherwise use them in a hundred or more different ways.

They are man-made substances and laymen are most familiar with them as fibers—the nylons, Dacron, Orlon, Acrilan and many others. Additionally we know them as films or sheets—Saran, Mylar, Teflon, etc., and as molded objects of which the very first arriving on the scene some 50 years ago, was Bakelite. Others are rubbers of varying properties.

Nature preceded man in the manufacture of macromolecules. Indeed, we ourselves are largely made up of macromolecules and one of the "synthetic" fibers we know well is actually made of naturally occurring large molecules. Rayon originally was a regenerated cellulose product, the high polymers coming from wood or other vegetable forms.

MACROMOLECULES are simply what their name implies—very large size molecules. Where the molecular weight of water is given as 18.02 and that of lead, 207.21, some of the biggest man-made macromolecules have a weight of 200,000 molecular units and some can go as high as 1,000,000. Molecular weights of so-called super-high polymers looked for in the future, it is estimated, will be in the millions. (One of 10,000,000 molecular weight has already been made in the laboratory.)

MONOMERS are the basic building blocks of polymers. A monomer is one molecule of one relatively simple compound. Polymers are combinations of the molecules of one or more monomers that have been chemically joined. Comparatively speaking, there are only a few monomers now of commercial importance in the making of man-made high polymers, and most of these are organic compounds. In the coming world of super-high polymers, certain metal-organic compounds will be of great importance.

IN 1959, in the United States alone, the annual capacity of plants making only synthetic high polymer fibers was estimated at 2375 million pounds. This amounts to more than half the world's total capacity, although foreign sources of supply are growing very rapidly. It is estimated that about 10 percent of this country's total use of fibers is made up of the true synthetics as compared to about 4 percent for the world. (Cotton still leads by an overwhelming margin—68 percent.) It is further estimated that more than two-thirds of all rubber used today is man-made!

The beginning of the development of polymer chemistry as pertains to commercial applications has been attributed to a number of occasions of which the most important may well be the synthesis by Leo H. Baekeland of Bakelite at the turn of the century. The most remarkable developments, however, must be attributed to the Du Pont laboratories. Never in the history of industry did basic research pay off so quickly or so handsomely as did the development of nylon. (The synthetic rubber, neoprene, was an outgrowth of the same experimentation that produced nylon.)

HIGH POLYMERS today are tailored to order. Scientists know enough about the make-up of these substances, and how to arrange the individual monomers in the polymeric chain, to come up with a substance of just about any desired property. Old ones are being made increasingly useful, too, by altering them slightly as in the case of polyethylene in which density changes have resulted in a whole family of useful and unique substances.

There are about 40-odd readily available organic monomers that are used to make the fascinating and fantastic assortment of macromolecules that we use today. Actually the number of combinations possible are virtually limitless, although the useful combinations are probably less numerous. The majority of these basic building blocks are derived from coal and oil.

PUTTING monomers together is a rugged business. The early high polymers required extremely high pressures and temperatures for formation. Now, with newly discovered catalysts, certain macromolecules can be made at much lower temperatures and pressures. Nevertheless it is true that a great many of the monomeric compounds used are gaseous or fluid at reaction temperatures. To handle them in the quantities required calls for some impressive compressors and vacuum pumps as well as fluid pumps.

All types of machines are needed. Big, high-capacity, low-pressure centrifugal gas-handling machines sit side by side with high-powered, high-pressure reciprocating units. Either type may be of special materials to handle such highly reactive substances as the chlorines and fluorines. Many reciprocators will operate on special composition rings to avoid contamination or poisoning of the reactants with hydrocarbon lubricants. Nonlubricated air compressors are called on to supply pneumatic controls which are increasingly taking over the monitoring of the complex operations.

A hundred or more separate pumps may be involved in one reactor setup and be made of a variety of materials and use a number of different types of seals. Process steam is important to many operations and a variety of steam equipment from ejectors to condensors is found installed in the polymer producing plant.

And, not only are compressors and allied machines necessary to the actual production of macromolecules, they are used in preparing the monomeric compounds originally. The winning of the raw materials coal and oil from the ground is equally dependent on compressors and pumps. Indeed, it might well be said that high polymers are founded on a base of compressed-gas and fluid-transfer technology, a science that has grown at a pace more than adequate to meet not only current requirements of the makers of macromolecules, but their future needs as well.

Assisting Astronauts into Space

A SAVING WITH AIR POWER APPLICATION

WHEN the Mercury astronauts are away from earth on their first trips into space, air power will have contributed directly to making their missions possible. Modified shells of the U. S. Army's Redstone missile are to be used for the launchings; these units are fabricated by the Reynolds Metals Company missile plant at Sheffield, Ala.

For a long time one of the biggest problems at the plant was the task of metal/inert-gas girth-welding of the aluminum shells. The welding unit sat idle for hours during the painstaking work of aligning the two shells that form the space component. Not until this alignment was completed could the welding begin.

What was needed was a compact welder that could move to the various weld set-ups: more time would be spent on welding and less on alignment and set-up, per shell. To solve the problem, the plant engineering department designed a gantry welder. It supplies the stability of a fixed unit with the flexibility of a movable one, along with high precision automatic features.

Straddling the long aluminum shells, the gantry can move for a distance of 180 feet and carries all of its own basic welding equipment. The shells are rotated by a series of perfectly matched friction driving wheels along the floor track. The rotation, as well as all welding steps, is controlled by the operator at his console on the gantry.

When ready to weld, the operator drives to the work point and positions the unit's torch. His platform can be moved to within an inch of the shell for better observation but moves out as necessary to clear the shell clamp and tracking rings.

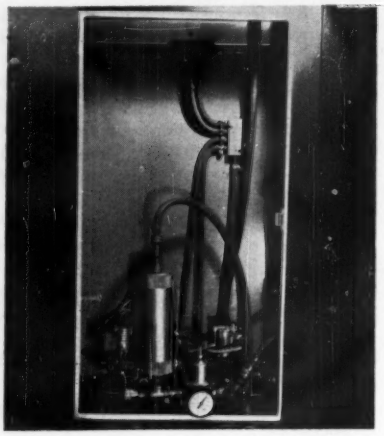
Four air cylinders, with shoes on their rod ends, are mounted vertically, one at each corner of the gantry base. Controlled by solenoid valves, the shoes are lowered to the floor when the machine is in position to weld. The air "feet" hold the welder rigid, insuring that there is no movement during the critical welding period.

Air lines to the welder travel along on an overhead track and trolley system. The air manifold serving the cylinders, plus valves, couplings and a filter, are located in a cabinet on the side opposite the operator.

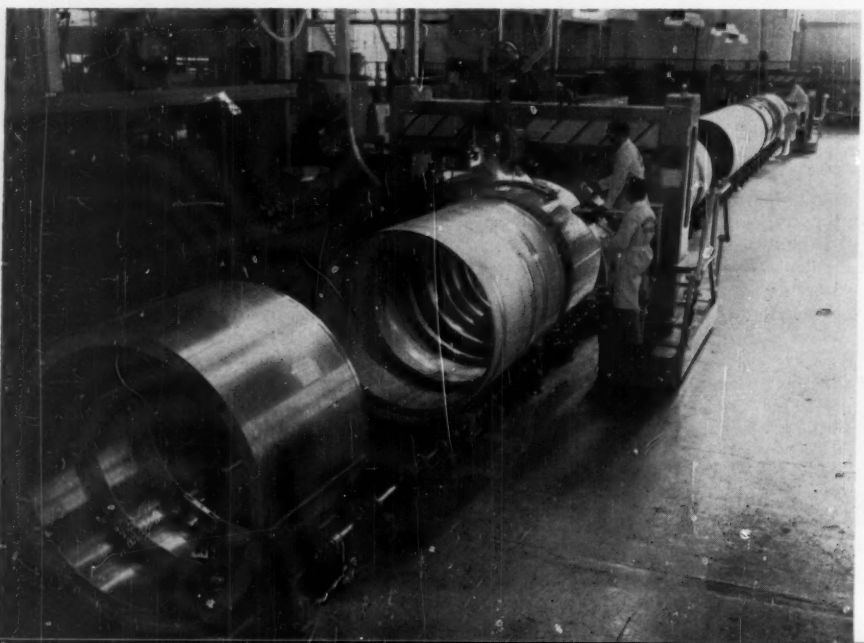
Work can now be carried out on as many as ten different points along the track with the welder rolling into position only when the facing shells are fully prepared. Because the driving wheels for the shells can be disengaged in 8-foot sections, set-up and tear-down work can continue while welding is in progress elsewhere on the track.

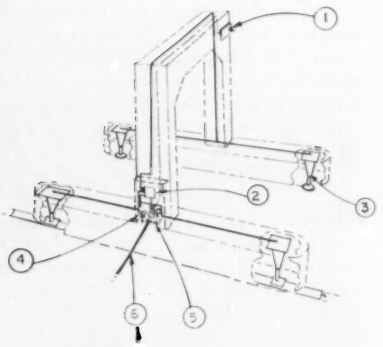
Besides contributing to the country's race into space, the air-equipped welder has allowed quality to be kept at a high level while production has been speeded many times. When Reynolds officials saw the advantages of the gantry welder and the output of its first 16 months, a second such unit was built.

AIR PANEL This close-up view shows air equipment in the gantry: hose manifold, solenoid valves, filter, regulator and quick couplings

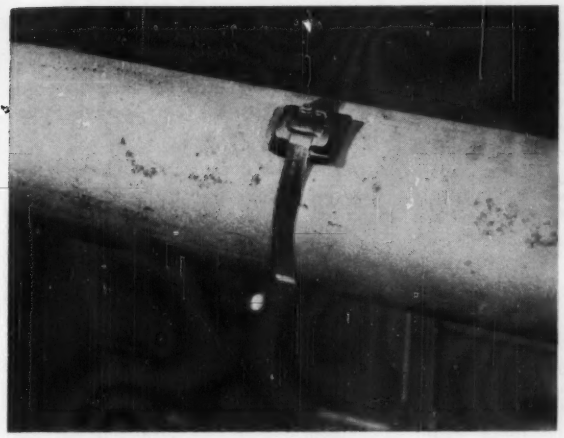


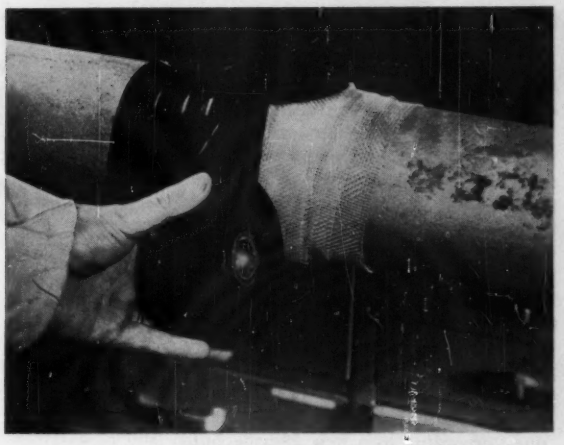
GANTRY WELDER Straddling an aluminum Redstone missile shell, the Reynolds Metals Company's movable gantry welds a seam. The aluminum shells rest on matched friction driving wheels along the floor. Air cylinders mounted in four corners of the gantry are lowered to give the steady base necessary for the precise welding.





AIR SYSTEM The gantry's air components include: (1) 3-position selector switch; (2) air manifold; (3) air cylinder; (4) pressure regulator and filter; (5) solenoid pilot valve; and (6) main air supply.





Permanent Patches

PIPE REPAIRS that take a minimum of time and that do not require specially trained men are always welcome in the fluid power field. Minnesota Mining & Manufacturing Company, St. Paul, Minn., has developed just such a system. Offering the advantages of thermosetting epoxy resins, the pipe repair system can be used on any diameter pipe operating at pressures as great as 100 psig. Furthermore, the method requires a minimum inventory of materials for repairs on all sizes of pipe. The average workman can fix a small hole in a 6-inch pipe in 10 to 30 minutes, depending on working conditions and his experience.

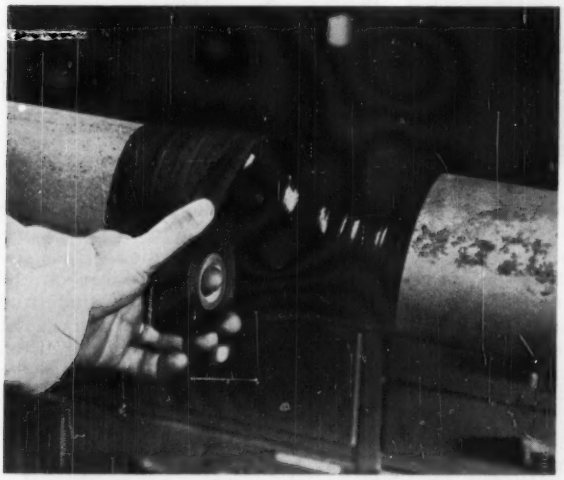
Although developed primarily as a safe, reliable means of repairing gas transmission and distribution lines without the use of open flame and without entirely removing the line from service, this technique can be used for liquid piping repairs, as well as for joining and patching plastic pipe. The epoxy used is Scotchcast brand electrical resin No. 4. This is not affected by gasoline, fuel oil, crude oil or other hydrocarbons, and it resists most chemicals. Practical operating temperatures of the resin are limited by extremes of pressure and by increased corrosive action at higher temperatures. However, according to company spokesmen, the epoxy itself will withstand continuous operating temperatures in excess of 200° F.

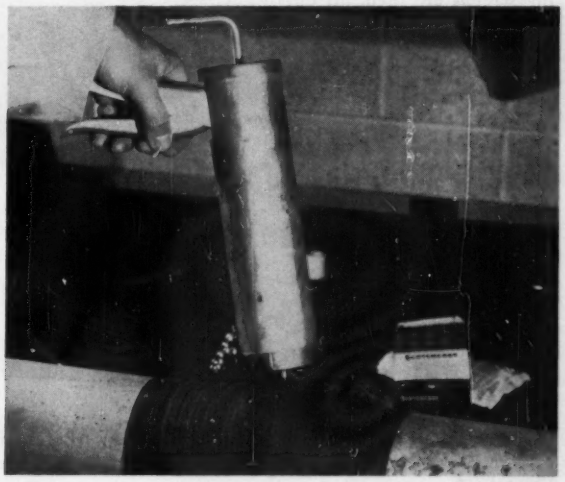
Using application techniques developed in electrical cable splicing, the repair system utilizes what is called the Scotchcast resin pressure method. The area adjacent to the hole or crack to be repaired is first cleaned with a wire brush and solvent. This assures a maximum bond of the epoxy to the pipe. The hole is then covered with a patch made of several folds of Scotch brand electrical tape No. 22. If pressure within the pipe is too great, a steel pressure band may be applied, as shown in the top left photograph. Any method may be used to plug the leak in a pipe under pressure, so long as it will hold for about 2 hours.

Layers of spacer screen are next wrapped over the plug. This serves as a porous framework, or mold body, for the resin. The thickness of the screen wraps depends on the pressure carried in the pipe. The injection fitting is positioned and the entire area is wrapped with a length of electrical tape No. 22. This operation can be seen in the photograph at top right. The tape is placed with a half-lap wind, and serves as the resin container, or mold.

The picture at the bottom left shows the next step in the process—the wrapping of a layer of cloth restricting tape over the electrical tape. This provides the necessary physical strength to hold the resin while it is a liquid and under pressure.

Resin is prepared and inserted in a hand gun. The nozzle of the gun is positioned in the injection fitting. Smooth, slow strokes on the gun handle (lower right) force the resin into the mold under a pressure of about 100 psig. After 30 minutes the resin is hard, and curing is completed in another 2 hours. Backfilling, following field repairs, can be started in 10 minutes.





Industrial Notes

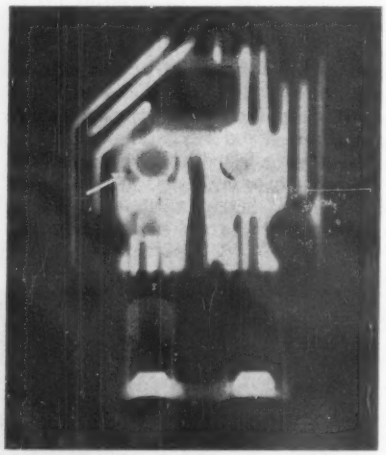
MECHANICS and shop owners can increase output 5 to 20 percent by replacing old impact wrenches with new ones, according to a new 28-page bulletin published by Ingersoll-Rand Company. The manual contains time studies on nine common service operations on sixteen makes of automobiles. It also describes the company's complete line of air and electric Impactools and accessories used to increase production and flat rate billing by saving time and effort on automotive repair operations. Information on $^3/_8$-, $^1/_2$-, $^5/_8$-, $^3/_4$- and 1-inch square drive air and electric Impactools, plus sockets and accessories such as multipurpose chucks, screw driving bits, stud removers, angle attachments, extensions, universal joints, wire brush attachments and the like, are contained in the bulletin, Form 5191A. *Ingersoll-Rand Company*, 11 Broadway, New York 4, N. Y.

THE ADVANTAGES of CO_2 Flash Curing, such as elimination of baking and drying, savings in time and space, improved dimensional accuracy, reduction of scrap, core handling and finishing time, and the like are treated in *Pureco CO_2 Serves the Foundry Industry*—an 8-page brochure (Form ADPC-27A) recently published. A 2-page explanation of exactly how the process operates, complete with schematic drawings and photographs of actual molds and cores being hardened, is included. In addition, ways to control carbon dioxide for maximum effectiveness and economy, use of standard molding equipment with the process, and the technical service available from Pureco are detailed. *Air Reduction Company Inc.*, Pure Carbonic Company, 150 E. Forty-Second Street, New York 17, N. Y.

HOSE for high-pressure air and hydraulic applications has a special polyamide inner tube with a high tensile strength polyester braid reinforcement, and is covered with an abrasion-resistant polyamide jacket. It is reported to withstand burst pressures comparable to SAE 100-R1 wire braid hose, and has good flex-impulse strength. Further, it is not affected by nonflammable hydraulic fluids to 200° F and by flammable fluids to 225° F. The hose is available with both reusable and permanently attached couplings. *The Imperial Brass Manufacturing Company*, 6300 W. Howard Street, Chicago 48, Ill.

TECHNICAL bulletin (No. BFD-180) is a 2-page, 2-color sheet discussing Porostrand, a type of porous metal made by wire-winding techniques. It details both filtration and nonfiltration applications. Typical uses are listed together with Porostrand features, which include a wide size range of finished structures—from $^1/_2$-inch diameter and $^3/_8$-inch

Ghosts of Science Fiction?



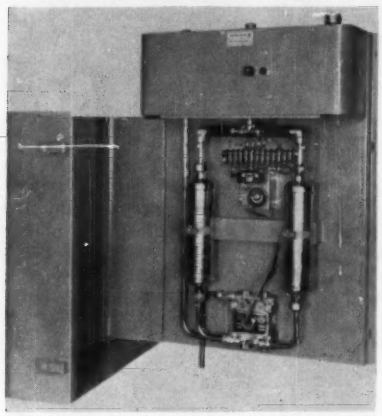
THE eerie looking death's heads appearing in the two illustrations are in reality industrial X-ray films of a cast cylinder head before and after the use of lead screens to intensify the image and reduce scattered radiation. After the intensifying screens are used, an important flaw becomes apparent. This is a blowhole and appears as a small circular area on the rim of the left valve port (arrow).

These unusual pictures were made on Ilford Type G Industrial X-ray film, which is an extremely fast, medium-contrast film of medium-grain size. It is recommended for use when speed is of primary importance. To take the right-hand picture, a pair of Ilford lead screens was used to obtain these results. A 0.006-inch lead foil screen was placed in front of the film, and behind it, a 0.010-inch one. They are used because less than 1 percent of the X-ray energy of primary radiation is absorbed by the film without them. By clamping the film between two lead foil screens in a film holder, photographic action on the film is considerably increased. Such intensification results mainly from the absorption by the film of photoelectrons emitted by the lead under the action of radiation. Further, lead screens absorb the longer wave length scattered radiation much more than the primary radiation. Consequently, they greatly reduce the amount of scattered radiation reaching the film. Last, film electron absorption intensifies the primary beam more than the transmitted scattered radiation. This and the previous effect produce greater contrast clarity of the radiographic image by diminishing the over-all haziness produced by scattered radiation.

Hidden casting defects that can be found through the use of industrial X-ray techniques include cracks, hot tears, stress cracks, cold shut, shrinkage, gas holes, core shift, surface irregularities and misruns. Weld defects that can be determined are nonmetallic inclusion, lack of fusion, incomplete penetration, porosity and cracks.

length, to 48-inch diameter and 120-inch length. *The Bendix Corporation*, Bendix Filter Division, 434 W. Twelve-Mile Road, Madison Heights, Mich.

KAHN MPS-5 is a heaterless dryer with a rated capacity of 3.55 cfm of compressed air dried to a dew point of —40° F or lower. (Larger flows are obtainable if higher effluent dew points are satisfactory.) Operating pressures range



from 80- to 150-psig line pressure with saturated inlet air to 100° F. Over-all size of the unit is 24×18×6 inches, and it weighs about 35 pounds. The dryer is a dual tower device that provides continuous drying performance. While one tower is on a duty cycle, the other is reactivated by a purge of dry air. There is no heat source required. The dryer is designed to be incorporated in pneumatic control systems such as used with air conditioning installations in industrial and office buildings. *Kahn & Company*, P. O. Box 516, Hartford 1, Conn.

QUALICON SYSTEMS are designed for continuous measurement and control of moisture and density of materials on conveyor belts, in pipes, in bins and hoppers, and in tanks, mixers and blenders. Four of these instrumentation systems for industrial processes have been developed by Nuclear-Chicago. They provide measurement and control of:

(1) the bulk density of solid materials either on a conveyor belt or in a bin or hopper (Model 502);

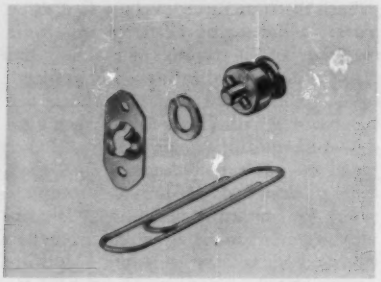
(2) the percent of moisture of solid materials on a belt or in a storage facility (Model 507);

(3) the specific gravity of solutions and slurries in pipes or tanks (Model 504); and,

(4) the percent of moisture of liquids or slurries in a process loop or in a tank (Model 509).

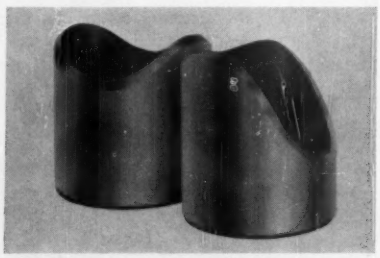
Each instrument series consists of three parts: a measuring head, an electronic read-out, and a recorder/controller that displays the desired information and controls the measured variable. Each can be provided with either analog or digital data presentation and control. All are based on nuclear methods, yet each system is designed to provide complete safety for operating personnel. Density measurements make use of gamma reflection and gamma transmission. Moisture measurements are accomplished by the principle of neutron reflection. *Nuclear-Chicago Corporation*, 359 E. Howard Avenue at Nuclear Drive, Des Plaines, Ill.

A SUBMINIATURE, $1/4$-turn quick-release fastener has been announced by Camloc. The 12F series is designed as a quick-operating fastener for light covers, small subassemblies and miniature "black boxes." The devices provide a high clamping force with an ultimate tension-shear rating of 150 pounds in minimum envelope dimensions. New receptacle design provides reduced size with $1/2$-inch rivet spacing, yet standard 0.062-inch-diameter rivets are used. Actual envelope dimensions of the receptacle are 0.285-inch wide, 0.680-inch long, and 0.102-inch high. A unique spring design in the stud assembly provides reach char-



acteristics not possible with designs using spring-type receptacles. Stud assemblies are available in length increments of 0.015 inch to assure adaptability to all grip range requirements. *Camloc Fastener Corporation,* Department 2C, 33 Spring Valley Road, Paramus, N. J.

PRESHAPED saddle fittings are available in 45-degree angles from Allied Piping Products Company, Inc. To this time, the bulk of the company's production has been in preshaped 90-degree saddle fittings. Manufactured of high-strength seamless tubing in three weight schedules, the new Allied fittings come in A-53 for most piping requirements and A-106 Grade B for higher pressure applications. The latter can be delivered with mill test certificates if requested. Sizes range from 1 through 12 inches for welding and 1 through 4 inches for threaded filling. All are beveled for welding. Special fittings of 1- through 36-inch aluminum, alloy or stainless steel are also available in any

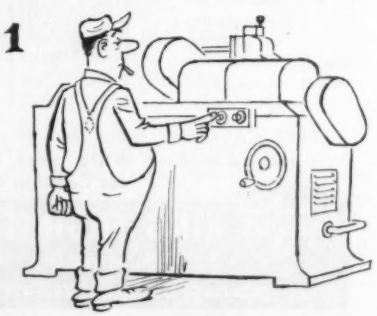


desired angle. Company officials report that the saddle fittings have been subjected to exhaustive testing—every size in the line has been tested many times and in every case, failure occurred in the run pipe before it did in the fitting or the connecting weld. *Allied Piping Products Company, Inc.,* Fittings Division, P. O. Box 311, Salem, Ohio.

PRESSURE REDUCING valves are the subject of Warren Engineering Company's 16-page bulletin (No. 402). It discusses design, operation, and typical applications of these units. Capacity charts and pounds of steam consumed at different steam pressures, for easy valve sizing and over-all general use, are included. The booklet is handy for all engineers concerned with reducing valves. *Warren Engineering Company,* Main Street, Broadway, N. J.

PUNCH-LOK has published two aids for all users of compressed air. One is a hanger card, F-255-A, that shows comparison costs of compressed air leaks. The chart illustrates the area of a leak by diameters in fractions of an inch, air loss by cubic feet per month at 75 psig, and dollar losses by cost of waste per month at $0.12 per 1000 cubic feet.

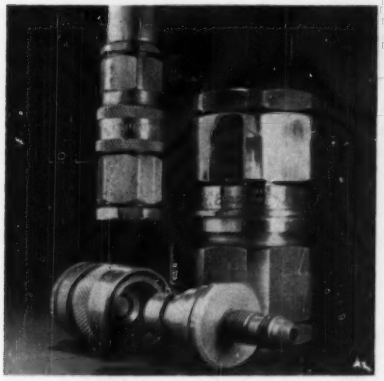
The other publication is a folder, F-310, that describes the company's hose



clamps, easy-to-use portable locking tools, its TA-1 Tension-Air production clamping machines, and K-45 Clamp-Master maintenance kit for fast, smooth clamping of hose, insulation, cable, split beams, etc. *Punch-Lok Company,* 321 N. Justine Street, Chicago 7, Ill.

PEDESTAL-BEARING-TYPE, heavy duty E-M synchonous motors are illustrated and described in a single-page product publication, 1100-PRD-253. These motors are available at 600 hp and up in speed ranges from 1800–500 rpm with 0.8 or 1.0 PF. The motors operate on standard voltages, 50 or 60 cycle. *Electric Machinery Mfg. Company,* Minneapolis 13, Minn.

SNAP-TITE quick-disconnect couplings can now be protected by nonelectrolytic nickel plating to provide virtually the same protection against corrosion previously guaranteed only by stainless steel,

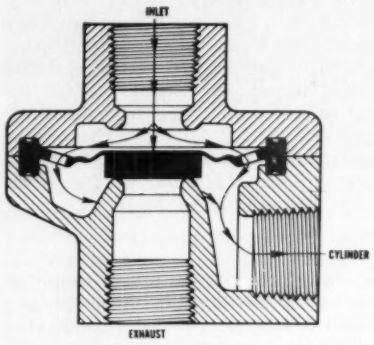


but at considerably lower cost. The "electroless" plating on the coupling is free of voids. A major reason for this is that the plating exhibits no destructible crystal structure; thus there is virtually zero porosity. Under normal conditions, abrasion resistance is very good, and the new plating process produces no effect on the tensile strength or ductility of the steel in the couplings. Coating adhesion is excellent, with reported values in the range of 30,000–60,000 psig. When tested to the extreme, actual microscopic observation has shown that the separation line is in the coating and not between the coat and the base metal. A few of the couplings that can be provided with the plating are shown here. *Snap-Tite, Inc.,* 201 Titusville Road, Union City, Pa.

PNEU-TROL quick-exhaust valves are a recent product of Auto-Ponents, Inc. Each unit incorporates smooth, oversize, unrestricted internal passages to prevent clogging from contaminated air lines, and a diaphragm of unique design to give instantaneous and complete venting of exhaust air from cylinders, air presses, and other air-operated equipment. By providing quick dumping of exhaust air at the cylinder, the valve eliminates the need for large-diameter piping and large selector valves ordinarily required to accommodate exhaust air moving back through a system. The initial savings and operating efficiencies made possible by the use of smaller air system components are of considerable importance. In addition, smoother, faster cylinder operation and wider application of air-powered motions are obtained, it is reported.

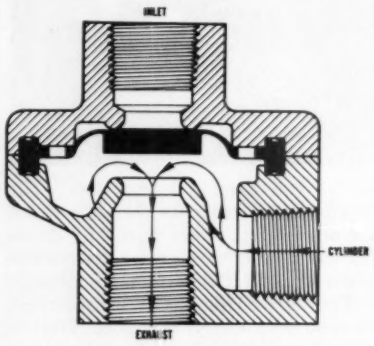
2

The simple 1-piece diaphragm and seal is molded of a tough, oil- and abrasion-resistant synthetic compound for long service life. Its design compounds exhaust pressure against the entire diaphragm area to provide fast, flutter-free opening and closing action. Air moving through the valve inlet port seats the center section of the diaphragm, closes



AIR INLET TO CYLINDER

the exhaust port (top drawing) and unseats twelve holes that are spaced around the periphery of the diaphragm. Air moves into the cylinder. Minimum resistance is offered to the incoming air because the combined area of the twelve holes exceeds the inlet port area. In the exhaust cycle (below) inlet pressure is

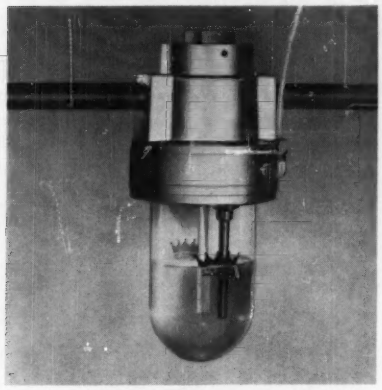


AIR EXHAUSTING FROM CYLINDER

relieved by the action of a selector valve in the control circuit and exhausting is instantaneous. The cylinder return pressure, building up over the entire diaphragm area, closes the twelve inlet holes and snaps the center seating section off the exhaust port to permit quick evacuation of exhaust air. *Auto-Ponents, Inc.*, 3001 Grant Street, Bellwood, Ill.

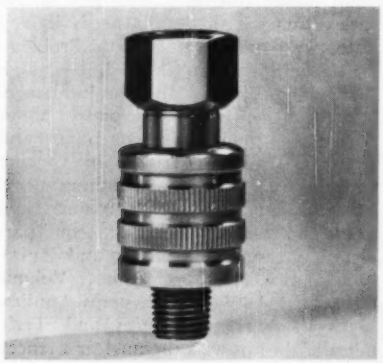
CROWN PULSE in-line lubricators deliver exactly the required amount of oil to the spot where lubrication is needed. The system operates on pressure variations (pulses) and is entirely independent of air flow rates and duration of flow periods. Because the outlet end of the oil delivery line may be placed in any

location, oil delivery to the exact spot desired is assured without the need for costly, auxiliary pressurized oil supply, according to company spokesmen. Advantages of this unit include positive



lubrication of air-operated equipment even when such equipment is located in high, overhead positions and when air flow through the lubricator is very low and/or infrequent. The Crown Pulse Lube delivers a metered amount of oil and controls the amount of lubrication feed accurately from very rich—a drop every 3 or 4 pulses—to very lean—a drop every 100 or more pulses. In addition, substantial quantities of oil are saved because it is not necessary to flood the air line with oil in an effort to get a little lube to the operating equipment. *Hannifin Company,* Dept. 156, Des Plaines, Ill.

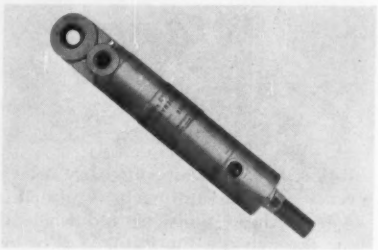
AIRMATIC Valve, Inc., has announced a 3-way, 2-position air-control sleeve valve. This low-cost, on-off valve has dozens of applications in every industrial plant where controlling, single-acting, spring-return cylinders automatically will speed production. It is compact in design ($2^3/_4$-inch long and $1^1/_8$ inches in



diameter) and can be installed quickly and easily in any position or any place on the production line—on the machinery itself or on the cylinder. Rugged in construction, it is made of corrosion-

resistant materials. Eight air-passage holes allow the valve to operate close to full capacity with low friction loss. *Airmatic Valve, Inc.*, 7313 Associate Avenue, Cleveland 9, Ohio.

HYDRAULIC cylinders for operation at 3000-psig pressure (reported to have been tested to 5000 psig at the factory) are available in bore sizes ranging from $1^1/_8$ through 12 inches, in all standard mounting styles. In addition a new clevis-mounted model may be had. It incorporates self-aligning spherical bear-



ings at both pin connections. This Pathon 3 H series, using the screw thread head-to-barrel retention method is compact and is offered with a wide selection of rod sizes and cushion controls. *Pathon Manufacturing Company*, 3823 Pacific Avenue, Cincinnati, Ohio.

Books . . .

Advances in Vacuum Science and Technology (published by Pergamon Press, Inc., 122 E. Fifty-Fifth Street, New York 22, N. Y.; 4 & 5 Fitzroy Square, London W. 1, England; 24 Rue des Ecoles, Paris V, France; or Am Salzhaus 4, Frankfurt, Germany) was edited by Professor E. Thomas. It is the proceedings of the first International Congress on Vacuum Techniques held in Namur, Belgium, in 1958, with Dr. Thomas acting as president of the congress. The first of the two volumes in this capital set is divided into two parts—"Fundamental Problems in Vacuum Techniques" and "Ultrahigh Vacuum." The first discusses fundamentals, then continues with papers about mechanical pumps, diffusion pumps and ejectors, problems arising in vacuum systems, leak detection, vacuum measurement, pumping speed measurement, and leads and connections. The second part details measurement, getter and ionization pumps, and applications. Volume II, subtitled "Vacuum Systems Applications in Various Sciences and Techniques," begins with the nuclear sciences, continues with metallurgy, the electron tube industry and related problems, biology, pharmacy and food industries, vacuum evaporation, vacuum concrete, and closes with such miscellaneous subjects as R. Thees' paper "Entluftung von

Dampfturbinenkondensatoren mit Rootspumpen," F. Pax Fernandez's "Le Vide dans les Sechoirs pour Bois," and D. H. Tantum's and F. Farrar's "A Vacuum Insulated Transfer Line for Liquefied Gases." For all those interested in the varied aspects of vacuum technology, the two books, printed in England, are a valuable record presented by international specialists. 824 pages. Cost $30 a set.

Films . . .

The Viewing Millions, although not a film, deserves space in this department, for the industry-sponsored motion picture has become a major force in communications, with a 50-year history as an educational and informational tool. The advantages of professional distribution of industry-sponsored motion pictures are described in this volume. It is a 24-page publication that states that the role and responsibilities of the distributor have increased manifold due to the great growth of the 16-mm "network" of sound projectors and television sets. A distributor's services should include continuous, creative promotion of a sponsor's film, utilizing direct mail, advertising, directory listings, publicity, convention exhibits and television; high-speed electronic film-inspection and cleaning of prints to preserve and extend their service life; assistance in the preparation and promotion of film-related teaching aids; national distribution from strategically located film centers that maintain close and continuing liaison with user groups; and monthly performance reports that provide a deep look at audience composition and size, as well as user evaluations of films. Copies of *The Viewing Millions* are available without charge to film sponsors, advertisers, agencies, producers, public relations firms, business and industrial associations, and national organizations. *Association Films, Inc.,* 347 Madison Avenue, New York 17, N. Y.

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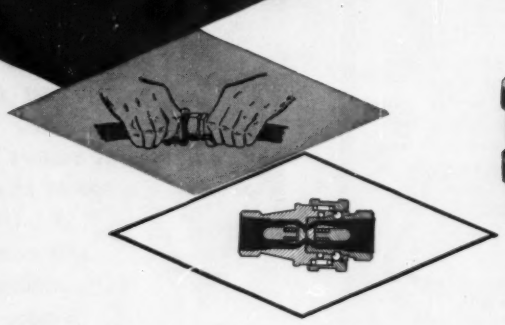
QUICK CONNECTION

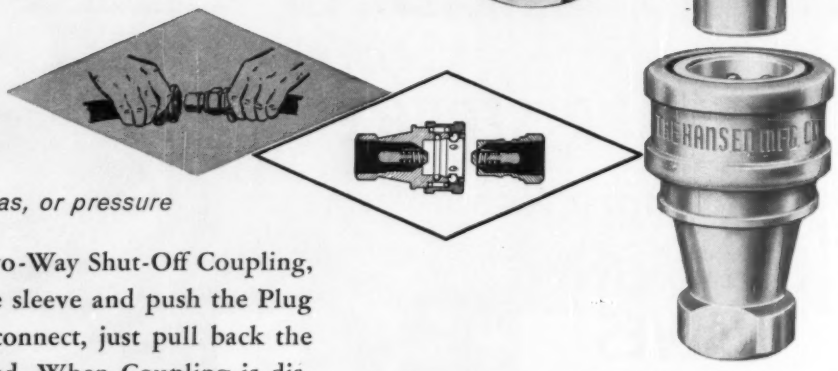
with instant automatic flow



QUICK DISCONNECTION

with instant automatic shut-off

...prevents loss of liquid, gas, or pressure



To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of line — practically eliminate spilling of liquid or escape of gas at instant of disconnection.

Available in brass or steel, with female pipe thread connections from ⅛" to 1½" inclusive.

Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings — including Special Service Couplings for LP-Gas, Steam, Oxygen, Acetylene, etc.

Representatives in Principal Cities ...see Yellow Pages

SINCE 1915

QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th. STREET • CLEVELAND 35, OHIO

ADVERTISERS INDEX

ENGINEERED METAL PACKINGS

for Pumps, Engines and Compressors

Selecting the proper metal packing—and packing ring material —assures positive, efficient sealing against gas, air, steam.

Specifying the right material for metal packings can make a big difference in seal effectiveness and packing life. Garlock offers a wide choice, each designed for specific temperatures and pressures:

GRAPHITIC CAST IRON. Unequaled wear-resistant qualities. Graphite assures continuous lubrication between packing and rod. Recommended against 1500 p.s.i. pressures, 800°F temperatures.

STANDARD HI-LEAD BRONZE. Chosen after years of research, this standard bronze has a yield point of 26,000 lbs./sq. in., a tensile strength of 31,250 lbs./sq. in. Can be used against 10,000 p.s.i. pressures, 800°F temperatures.

HI-LEAD SUPER BRONZE. Possesses a yield point of 14,750 lbs./sq. in., a tensile strength of 25,500 lbs./sq. in. Due to better wear properties, it can be used at pressures to 40,000 p.s.i., temperatures to 800°F.

AMBERITE—PLAIN OR GRAPHITIZED. Tough, strong, high impact strength. Excellent where corrosion and mildly difficult lubricant and wear conditions exist. Apply against 600 p.s.i. pressures, 250°F temperatures. Other grades available to meet various conditions.

BABBITT. Used on soft rods and where corrosion is present, lubrication is limited. Standard Babbitt has tensile strength of 10,000 lbs./sq. in. More expensive type has better wear qualities. Recommended for 5000 p.s.i. pressures, 425°F temperatures.

CARBON. Used where no lubricant is allowed. Generally affords the best wear-strength combination available. 700°F is recommended temperature limit; pressures may vary according to grade of carbon used.

TEFLON.* Far superior to many other rod packing materials because of outstanding chemical resistance, ability to retard wear and friction. Available in carbon- or glass-filled.

GARLOCK

Discuss metal packing materials with your Garlock representative. Call him at the nearest of Garlock's 26 sales offices and warehouses throughout the U. S. and Canada. Or, write for Catalog AD-166. Garlock Inc., Palmyra, N. Y.

Canadian Div.: Garlock of Canada Ltd.

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Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

*Du Pont Trademark for TFE Fluorocarbon Resin

high-pressure pumps

tailor-made

to your exact requirements

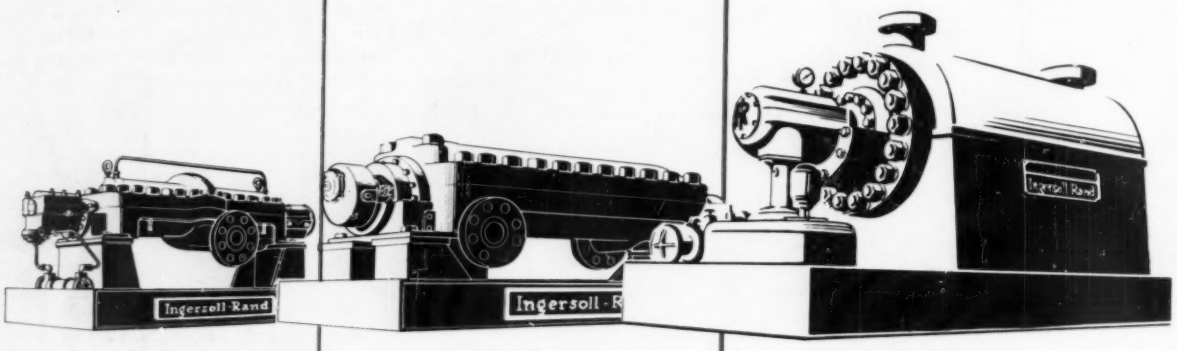
Whatever your high-pressure pumping requirements—for boiler feed, debarking, pipeline, refinery charge or cycling service—one of these I-R units is tailored to do the job dependably and *economically*. Covering the complete high-pressure range, up to 6500 psi, these pumps are designed to meet the specific operating conditions to best advantage, with efficiencies that stay high through years of continuous service.

All three of these high-pressure pumps have one thing in common—the "Unit-Type" rotor design. Shaft, impellers and interstage channel rings are assembled as a single, compact unit that can be easily removed for inspection or servicing. Maintenance is easier and there's less of it. All parts are precision machined for closer control of fits and clearances. Except for suction and discharge stages, all impellers and channel rings are interchangeable, reducing spare parts inventory. Multiple-volute passages in the channel rings assure complete radial balance at all loads, for longer bearing life and vibration-free operation.

PRESSURES to 1000 psi
CAPACITIES to 700 gpm

INTERMEDIATE PRESSURES
CAPACITIES to 2500 gpm

PRESSURES to 6500 psi
CAPACITIES to 7200 gpm



Class CNTA
Bulletin 7251

Class HMTA
Bulletin 7233-A

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